Service Manual

SCR Transformer Type Battery Charger

INTERIM SERIES

DEPTH RENEGADE LOAD HOG DEPTH RENEGADE

***D3E2** (SD3E2)*
***GTS2** (FGTS2)*
***LT2** (LTC2, SLT2, SLTC2)*
***D3G** (SD3G)*
***GTX** (FGTX)*

I.B. 1510
Rev.J

AC LINE VOLTAGE LETTER CODES

The following table describes the code letters to be used in new charger part numbers to indicate the AC line voltage(s) and AC line frequency at which the charger can be operated.

Code Letters	Voltage(s) (volts rms.)	Line Frequency (Hz)	Comments
B	208/240/480	60	Applicable to all charger families; single or three phase chargers.
D	220/380/440	50	Applicable to all charger families; single or three phase chargers.
J	480/550/600	60	Applicable to all charger families; single or three phase chargers.
T*	208	60	Use only for special designs; single or three-phase.
W*	240	60	Use only for special designs; single or three-phase.
X*	240/480	60	Use only for special designs; single or three-phase.
Y*	480	60	Use only for special designs; single or three-phase.
E	400	50	Use only for special designs; Contact the plant for further information.
S	SPECIAL VOLTAGES	UNSPECIFIED	Use only for special designs; Contact the plant for further information.
* Replacement part numbers for chargers with such letter codes shall be referred to the charger's tables with code letter "B"			

SPECIALTY CHARGER OPTIONS LIST

Check items included (✓)

✓	Suffix	Description	Kit part #**
	C	Charger Communication Module (Chargenet™)	N/A
	C6	6' of #10AWG AC Cord with 30 AMP Plug. *	X225-77-2
	C8	8' of #10AWG AC Cord with 30 AMP Plug. *	N/A
	C10	10' of #10AWG AC Cord with 30 AMP Plug. *	N/A
	C12	12' of #10AWG AC Cord with 30 AMP Plug. *	N/A
	CF	10' of #8AWG AC Cord with 50 AMP Plug. *	N/A
	CF12	12' of #8AWG AC Cord with 50 AMP Plug. *	N/A
	CR	6' of #10AWG AC Cord with 30 AMP Plug and 30AMP receptacle. *	X225-77-1
	D	Charger with AC Disconnect Switch.	See page # 92
	HD3	6' of #10AWG AC Cord with 30 AMP Plug. *	X225-77-2
	HD4	6' of #10AWG AC Cord with 30 AMP Plug and Receptacle. *	X225-77-1
	L13	13' of DC cable.	See page # 82
	L15	15' of DC cable.	See page # 82
	L18	18' of DC cable.	See page # 82
	L20	20' of DC cable.	See page # 82
	L25	25' of DC cable.	See page # 82
	L30	30' of DC cable.	See page # 82
	LM	SCR Charger with Load Management Control	N/A
	O	Special configuration of a standard EPROM	N/A
	P	Parallel DC cables, standard size.	See page # 93
	PP	Charger shipped on a Plastic Pallet	N/A
	Q	AC input change Quick Tap™	N/A
	S	Series DC cables	N/A
	T	Block Out Timer switch.	N/A
		Stacking Hardware Kit**	X225-99-0-2
		Wall Mounting Brackets**	X225-99-0-1
*When AC cord is installed at the factory only one input voltage is marked on the charger. **Accessories			

Note: refer specialty charger part numbers to the standard models contained in this manual.

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IMPORTANT SAFETY INSTRUCTIONS

1. This manual contains important safety and operating instructions. Before using the battery charger, read all instructions, **cautions**, and **warnings** on the battery charger, the battery, and the product using the battery.
2. Read and understand all setup and operating instructions before using the battery charger to prevent damage to the battery and to the charger.
3. **Do not** touch non-insulated parts of the output connector or the battery terminals to prevent electrical shock.
4. During charge, batteries produce hydrogen gas which can explode if ignited. Never smoke, use an open flame, or create sparks in the vicinity of the battery. Ventilate well when the battery is in an enclosed space.
5. **Do not** connect or disconnect the battery plug while the charger is on. Doing so will cause arcing and burning of the connector resulting in charger damage or battery explosion.
6. Lead-acid batteries contain sulfuric acid which causes burns. **Do not** get in eyes, on skin, or on clothing. In cases of contact with eyes, flush immediately with clean water for 15 minutes. Seek medical attention immediately.
7. Only factory qualified personnel can service this equipment. For service, contact the nearest *EnerSys Battery* authorized representative (1-866-443-9433)
8. De-energize all AC and DC power connections before servicing the charger.
9. The charger is **not** for outdoor use.
10. Do not expose the charger to moisture. Operating **conditions** should be 0º to 104º F; 0 to 70% relative humidity.
11. Do not operate the charger if it has been dropped, received a sharp hit, or otherwise damaged in any way.
12. For continued protection and to reduce the risk of fire, install chargers on a floor of non-combustible material such as stone, brick, or grounded metal.

WARNING: The shipping pallet must be removed for proper and safe operation.

INSTRUCTIONS DE SÉCURITÉ IMPORTANTES

1. Ce manuel contient des informations importantes sur la sécurité et le fonctionnement. Avant d'utiliser le chargeur de batterie, lire toutes les instructions, les précautions et les avertissements sur le chargeur de batterie, la batterie et le produit utilisant la batterie.
2. Lire et comprendre toutes les instructions de configuration et de fonctionnement avant d'utiliser le chargeur de batterie pour éviter de détériorer la batterie et le chargeur.
3. Ne pas toucher les parties non isolées du connecteur de sortie ou les cosses de la batterie pour éviter une électrocution.
4. Pendant la charge, les batteries produisent de l'hydrogène qui peut exploser s'il est enflammé. Ne jamais fumer, utiliser une flamme vive, ou créer des étincelles à proximité de la batterie. Bien aérer si la batterie est dans un lieu clos.
5. Ne pas connecter ou déconnecter la batterie pendant que la sortie du chargeur est sous tension. Cela pourrait déclencher un arc et brûler le connecteur entraînant des détériorations du chargeur.
6. Les batteries plomb-acide contiennent de l'acide sulfurique qui cause des brûlures. Éviter le contact avec les yeux, la peau ou les vêtements. En cas de contact avec les yeux, rincer immédiatement à l'eau claire pendant 15 minutes. Consulter immédiatement un médecin.
7. Seul le personnel d'usine qualifié peut entretenir cet équipement.
8. Supprimer la tension des connexions électriques alternatives et continues avant d'entretenir le chargeur.
9. Le chargeur ne doit pas être utilisé en plein-air.
10. Ne pas exposer le chargeur à l'humidité.
11. Ne pas utiliser le chargeur s'il est tombé, s'il a reçu un coup violent, ou s'il a été détérioré de toute autre manière; appeler ou expédier l'appareil au centre d'entretien autorisé *EnerSys General Battery* le plus proche.
12. Pour une protection continue it pour réduire le risque d'incendie, installer les chargeurs sur le sol ou sur un matériau non-combustible comme la pierre, la brique, ou du métal mis à la terre.

INSTALLATION

WARNING: The shipping pallet must be removed for proper and safe operation.

LOCATION

For maximum trouble-free service, choose a location that is free of excess moisture, dust, and corrosive fumes. Also, avoid locations where temperatures are high or where liquids will drip on the charger. Allow six (6) inches of clearance at rear and sides of the charger for air circulation. Do not obstruct the ventilating openings or the space under the charger.

STACKING MULTIPLE CHARGERS

These chargers can be stacked up to a maximum of 3 units high. Chargers are not designed to be stacked side by side due to ventilation requirements.

1. Position the first charger so that a minimum of 6 inches of space is between the charger and any wall, and 12 inches between the charger and any other equipment.

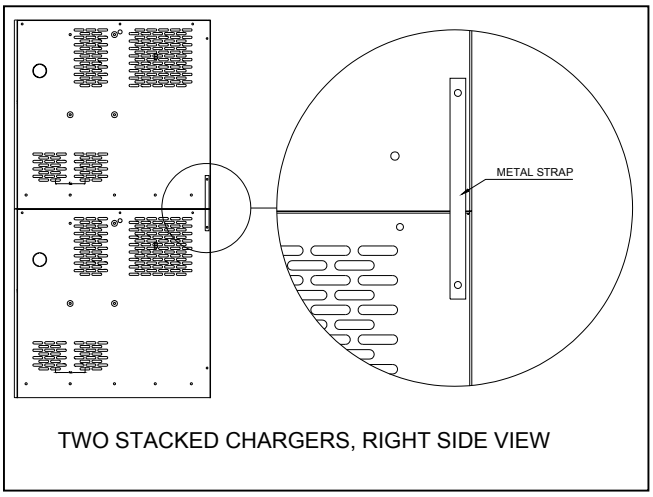
2. Place the second charger on top of the first. Align the bolt holes on each charger.

3. Fasten both charger cabinets together securely using 3/8” bolts and nuts.

NOTE: the two bolts toward the back of the charger may be omitted if an after market metal strap (about 8 inches) is used to secure both chargers. Remove existing 1/4" screws of the chargers' sides and attach strap with screws. Refer to picture.
Hardware kit # X225-99-0-2 can be ordered to attach two chargers.

4. Repeat steps 2 and 3 for the third charger.

5. Stacked chargers must be fastened to the wall using devices suitable for the wall construction and the bolt holes at the top of the highest charger.



TWO STACKED CHARGERS, RIGHT SIDE VIEW

NOTE: Ambient temperature at all levels cannot exceed 104^{O}F / 40^{O}C.

ELECTRICAL CONNECTIONS

To prevent failure of the charger, be sure it is connected to the correct line voltage.

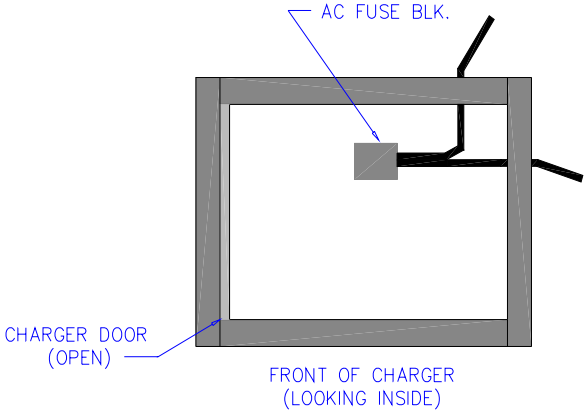
ON THREE PHASE UNITS

Connect all the charger as follows:
Phase A to L1 (fuse block)
Phase B to L2 (fuse block)
Phase C to L3 (fuse block)

CONNECTING INPUT POWER

WARNING: Make sure the disconnect is in the OFF position and the battery is disconnected before connecting the input power to the terminals of the charger.

Connect the input power to the appropriate terminals, ***including ground***. Follow your local electrical or National Electric Code in making these connections.
The figure that follows shows both the top and right side installation options for routing the incoming power cable.



IMPORTANT: When the AC Disconnect Switch is factory installed connect the input power to the Switch instead the AC fuse block.

BRANCH CIRCUIT PROTECTION
The user must provide suitable branch circuit protection and a disconnect method from the AC power supply to the charger to allow for safe servicing. (Even if the charger has an optional factory installed Disconnect Switch)

PLUG POLARITY
The charging cable is connected to the DC output of the charger with the positive lead marked RED. The output polarity of the charger must be strictly observed when connecting to the battery (read warning above).
Improper connection will open the DC fuse.

GROUNDING THE CHARGER

DANGER: FAILURE TO GROUND THE CHARGER COULD LEAD TO FATAL ELECTRIC SHOCK. Follow National Electric Code for ground wire sizing.

Connect a grounding conductor to the lug provided on the horizontal support panel. This lug is marked as shown:

THEORY OF OPERATION

INTRODUCTION

EnerSys SCR Battery chargers are three phase, 50 or 60 Hz, and SCR/Diode Block-controlled.
D3E2 and GTS2 chargers use the control board known as "D3E2". LOAD HOG chargers use the control board known as "LT2". D3G and GTX chargers use the control board known as “D3G”. Refer to the control board operation instructions within this manual for more information.

SCR/Diode Blocks are used to control the output and yield tight regulation over the whole operating curve. Line variations of ±10% will have almost no effect on the operating curve.

All chargers are designed for convection cooling with no derating, up to an ambient temperature of 40°C, 104°F (if properly installed per the Installation and Operating Instructions manual).

All models have an Equalize cycle that can be started manually or automatically.

While charging, the information about the state of charge is provided through the control board's LEDs and display.

Batteries rated from 64% to 200% of the charger AH rating can be charged without adjustment. Batteries outside of this range can be charged when the charger is adjusted.

When available with the line contactor (LTC2 & SLTC2) the power transformer is only energized as needed. Therefore, there is a special control transformer providing power to the board before the contactor is energized. This control transformer also provides 24V control for the contactor coil.

Refer to the schematic diagrams in the back of this manual as you read the following description.

The 3-phase SCR-controlled battery chargers are available with several operating voltage ranges and come in 50 or 60 Hz models. The voltage, current, and frequency ratings are specified on the nameplate located on the lower-left corner in the front of the charger. **It is important not to exceed any of these nameplate ratings.**

The charger power circuitry contains a transformer that provides full isolation from the primary utility source to the secondary.

In the LTC2 with line contactor, an AC line contactor controls power to the primary of the main transformer. It is under the direct control of the control circuitry and applies power only when current is required for charging a battery.

In the transformer secondary, there is a 3-phase bridge rectifier made up of 3 SCR/Diode Blocks, which converts AC to DC for charging.

The AC voltage of the secondary is connected directly to the SCR/Diode Blocks.

For increased reliability there is a snubber assembly connected across each SCR/Diode Block to limit the gate firing noise and high voltage spikes. Each snubber assembly consists of an MOV (Metal Oxide Varistor), which is a device used to clamp positive or negative voltage spikes at a given level and a capacitor (used to limit DV/DT on the SCR) in parallel.

The magnitude of the secondary AC voltage can be measured across the inputs of the SCR/Diode Blocks, and the values are listed in the troubleshooting section of this manual.

Each primary input line is individually fused, and in some cases, the charger may have been provided an optional AC fused disconnect switch. This switch, when it is on, prevents the front door from opening.
The secondary DC cable is fused on the negative lead.

Chargers rated at 36 cells and higher will have a different style fuse designed to clear at higher voltages. This will typically be a FWA style semiconductor fuse.

If the charger has been provided with optional parallel DC cables, each of the 2 negative leads will be individually fused with a size 1/2 of the rating of a single-cabled charger of similar rating.

PRINTED CIRCUIT BOARDS

All charger functions, features, and controls are handled by (1) printed circuit board (PC board) under microprocessor control. Because of its flexible design, this PC board model is capable of being used on an entire range of chargers.

If changes are required on a board that is already installed, then all adjustments, calibrations, and settings are made through the front panel using the push-buttons and the display. The specific operation of all adjustments through the front panel are described in detail in later parts of the manual. The adjustments are permanently stored in an on-board EEPROM (Electronically Erasable Programmable Read Only Memory chip). If AC power is lost while battery charging is in process, data will be saved in RAM. This allows the charger to return to where it left off when power is restored. NOTE: There are no trimming potentiometers located in this charger.

Caution must be observed when handling or taking measurements on the PC board. The control common, or ground, is tied to the positive battery buss. This is especially important to consider when taking measurements on the board while it is operating.
Note: Load Hog-40-850D models have been specially configured with an auxiliary circuit board to adjust the control sense winding voltage to the proper level for the main control circuit board.

CONTROL CIRCUITRY

The control circuitry measures current via the precision shunt located in the positive lead of the charger. DC Voltage is measured by means of a precision resistor circuit.

WARNING:	Under no circumstance should the starting current be adjusted to higher than the charger's ampere-hour nameplate rating times 0.16, or overheating of the charger will occur.

The control circuitry has three phases of charge cycle. But, when set for SEALED it has four:

1. Constant-Current control at the start-current setting and at the finish-current setting, and
2. Constant-Voltage control at the Gassing-Voltage (80%) point setting.
3. Constant current at finish rate.
4. Finish voltage will not exceed 2.53VPC (SEALED configuration only).

These modes of operation are determined by the recharge characteristics described in the following sections.

The control circuitry is connected to 3 small windings off the main transformer through connector J2. The value of these AC voltages can be found in the troubleshooting section of this manual. These windings serve several purposes:

1. Provide the signals which enable the control circuitry to synchronize and determine the proper phase angle to gate on each SCR.
2. Provide the signal by which the controller monitors the utility voltage. How the controller exactly interprets this voltage is dependent on the transformer code, which is described later. The controller will give an AC fault if any of the 3 phases drops to approximately 90% of the input voltage, or if any of the 3 AC fuses clear.

Each SCR is gated with a DC pulse. The red lead of the SCR is tied to control common, and the white gate lead is tied to the gate-firing circuit on the control circuitry. The control will automatically balance SCR currents to within 10% at the beginning of each charging cycle.

Refer to later sections of the manual for specific measurements and values that can be expected for normal charger operation.

OPERATING INSTRUCTIONS

Read the specific Operating Instructions for your charger.
Three types of control boards are available for 3 phase SCR chargers. The Operating Instructions are different depending on the control board. Settings are referred to **Flooded Cell** typed batteries, unless otherwise defined and marked with **Sealed Cell** settings. Operations of the PCB remain the same for either Flooded or Sealed Cell, within each type of control board.

DEPTH & rENEGADE CONTROL BOARD

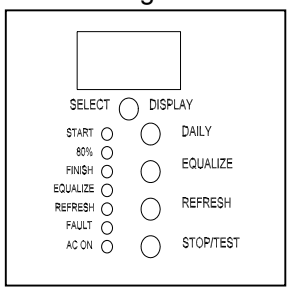
(D3E2 and FGTS2 are factory set for Flooded. And SD3E2 and GTS2 are factory set for Sealed).

NORMAL CHARGER OPERATION

When a battery is connected to the charger, the charger control circuitry measures the battery voltage to determine that the battery is within the charging range. The control circuitry begins constant current control by measuring the voltage across the shunt. This measurement is used as the current feedback signal for controlling the phase angle at which each of the three SCR/Diode Blocks are gated on. The higher the feedback signal, the more the SCR/Diode Blocks are retarded, and the shorter the SCR/Diode Block gate pulse in order to maintain current. Conversely, the lower the feedback signal, the more the SCR/Diode Blocks are advanced, and the longer the gate pulse in order to maintain current control. Loss of the feedback signals can cause one of several faults described in the Error Messages section.

A similar operation occurs during constant voltage control. When the gassing voltage point is reached, constant voltage control begins, and the voltage across the battery terminal is measured. This measurement will be the new feedback signal, which is used to control the phase angle at which each SCR/Diode Block is gated on.

When finish rate current is reached, constant current control resumes, but at a substantially lower current level.



FRONT CONTROL PANEL

There are five push-buttons, seven LEDs (Light Emitting Diodes), and a display screen on the charger's Front Control Panel.

Front Control Panel
Push-buttons

Push-button	Description
Select/Display	Selects what will be seen on the display. Also used to change Charger Parameters.
Daily	Starts or Restarts a Daily charge cycle.
Equalize	Starts or Restarts an Equalize charge cycle. It can also convert a Daily charge cycle to an Equalize charge cycle or vice versa. Equalize also toggles Equalize ON or OFF until locked into Equalize of 3 hr.
Refresh	Starts a Refresh charge, or adds a Refresh charge to a completed Daily or Equalize charge cycle.
Stop/Test	Interrupts a charge in progress. If there is no charge in progress, it tests the LEDs and the display by lighting them for as long as the push-button is held down.

LEDs

LED	Description
Start	Lights and remains on when a charge cycle begins.
80%	Lights and remains on after the Gassing Voltage point begins (80% charge of 2.38 V/C Flooded cell; 2.37 V/C Sealed cell)
Finish	Lights and remains on when Finish current mode begins.
Equalize	Blinks when the current charge cycle is an Equalize charge cycle. Lights steady when the 3 hour Equalize mode begins.
Refresh	Blinks when Auto-Refresh is pending. Lights steady when the Refresh charge cycle begins. Blinks again after the Refresh is complete.
Fault	Lights when a fault occurs. The display will show the fault code. (Fault codes are described in this manual under error messages.)

LED	Description
AC On	Lights steady when AC power is applied to the charger. Blinks when a power fault occurs. Possible Problems: An AC fuse opened A controlled winding opened. A bad lug. A phase of AC interrupted. Wrong transformer code if a new board was installed. Low AC line. One phase opened.

The display shows information such as: Cycle counter (C=XX), Equalize Target (E=XX), currents, voltages, and times. It is also used to change the Charger parameters.

While the charger is outputting current, the display can be set to show the following:
Charger current - Volts per Cell - AH Returned - Time on charge
To see specific values in the display, press the Display push-button. The display will show d==X, where X is a number between 1 and 5. The following table describes what each number corresponds to. Each time the Display push-button is pressed, X increments. Releasing the push-button will cause the data corresponding to the X to display. If the charger is idle, then pressing and holding the Display push-button will display the AH returned and time on charge.

Display

Display Number	What is Displayed	Format
1	Charger current in amps.	000.0
2	Volts per cell (v/c)	0.000
3	Current and v/c	
4	AH returned, current, and v/c	0000
5	Time on charge, Current, v/c, AH	00:00

ERROR MESSAGES
The charger is constantly monitored for fault conditions. If a fault occurs, the charge in process is terminated, all data for that charge is lost, and the charger display shows the fault code.

Error Messages

Fault Code	Description
1.1.1.1	No current when expected. Possible Causes: Open DC fuse or partially melted fuse. Loose connection in output string. (shunt, cable lugs, etc.) Battery inter-cell problems. Loose or missing current feedback connections at pins 1 and 2 of connector J4.
2.2.2.2	No voltage when expected. Possible Causes: Loose Cell-Size jumper (JP4). Loose wire or missing connection at DC shunt.
3.3.3.3	Current greater than 110% of Start rate. Possible Causes: AC line surge. Battery cell failure. SCR/Diode Blocks failure during last use. Loss of voltage feedback signal at pins 3 and 4 of connector J4.
4.4.4.4	Voltage greater than 3.000 v/c. Possible Causes: Battery that has been sitting for months and is sulfated. Finish rate set too high for the battery. Wrong cell size applied to charger. Cell-Size jumper (JP4) set incorrectly.

Fault Code	Description
5.5.5.5	Failed to reach the Gassing Voltage point before the Charge Time Limit was reached. Possible Causes: Check Gassing Voltage point and v/c at the battery terminals vs. the display. Extended cable length from original cables. This could indicate a defective or mismatched battery. Make sure charger is set to the proper Start Rate, not to exceed the AH rating of the charger. Battery AH may be larger than the charger's AH rating. Check battery temperature. It may be hot. Battery may have been over discharged.
6.6.6.6	Failed to complete the Constant Voltage mode before 1/2 Charge-Time Limit (1/2 of parameter #10) was reached. Possible Causes: Check Gassing Voltage point and v/c at the battery terminals vs. the display. Extended cable length from original cables. Battery AH may be larger than the charger's AH rating. Check battery temperature. It may be hot. Battery may have been over discharged. Battery may be defective. v/c does not rise above 2.38.
7.7.7.7	Failed to complete the charge cycle within the allotted time. Possible Causes: Check Gassing Voltage point and v/c at the battery terminals vs. the display. Extended cable length from original cables. This may have been an equalize cycle that was shut off by the maximum time limit. Check battery temperature. It may be hot. Battery AH may be larger than the charger's AH rating.
8.8.8.8	Amp-hours returned > 150% of charger amp-hour rating. Check time settings.
9.9.9.9	EEPROM write error. Occurs at the end of a charge but the charger runs OK. Contact service engineering.

A fault is cleared by disconnecting and reconnecting the battery, or by disconnecting the battery and pressing the Stop push-button. Determine the cause of the fault and correct it before reconnecting the battery and trying to charge it again.

Other Error Messages

B-HI	Battery voltage is higher than what control unit is set for.For example: 18 cell charger - 24 cell battery.
B-Lo	Battery voltage is lower than what control unit is set for.
Bloc	Shorting of pins 1 and 2 of J5 connector, or control unit has shorted components.
-AC-	AC line input voltage has fallen below 10% of the AC line. Example, 480VAC falls below 432VAC

FIELD ADJUSTMENTS

There are two levels of field adjustments:

1. User level.
2. Field technician level.

Setting Parameters

To change a number in the display, use the Up and Down Arrow pushbuttons in combination with the Refresh, Stop, and Select pushbuttons.

Pushbuttons Pressed	Holding	Display Changes By
UP- OR DOWN-ARROW	-	1
UP- OR DOWN-ARROW	REFRESH	10
UP- OR DOWN-ARROW	STOP	100
UP- OR DOWN-ARROW	STOP & REFRESH	1000

USER LEVEL ADJUSTMENTS

To enter the User level, hold down the Display and Daily pushbuttons at the same time. After approximately 5 seconds, the display will read "USEr". When this displays, release all the pushbuttons. The display should contain -01-.
The User level parameters can now be modified. Use the Up and Down Arrow pushbuttons to change the display.

The User level has three options that can be modified:

-01-Delay Start Option
-02-Equalize Counter Option
-03-Automatic / Manual Option

-01- Delay Start Option

This option is only functional when the charger is set to Automatic (User level -03- = 1).

The Delay Start option makes it possible to delay the start of the charge.
It can be set from a minimum of 0 minutes (00:00) to a maximum of 18 hours and 12 minutes (18:12).
Delay Start immediately begins counting down when a battery is connected to the charger.
If the Delay Start option is set to 00:00, charging will begin in about 5 seconds after a battery is connected to the charger.
The range is 00:00 to 18:12.
The factory setting is 00:00.

Changing Delay Start

To change or view the Delay Start option, enter the User level and have the display contain -01-.
Press the Select pushbutton. The current setting of Delay Start will appear in the display. Use the Up and Down Arrow pushbuttons to change the value in the display.
Press the Select pushbutton again to save the current setting in the display and to return to the User level.
After completing the User level adjustments, press the Stop pushbutton to exit, or continue to the next option by the Up or Down Arrows.

-02- Equalize Counter Option

This option is only functional when the charger is set to Automatic (User level option -03-).

The Equalize Counter option determines which charge cycle will be an equalize cycle. For example, if the Equalize Counter option is set to 5, every fifth charge cycle will be an Equalize charge cycle.
If this option is set to 1, and equalize will automatically occur every charge cycle when the charger is in Automatic mode.
If this option is set to 0, automatic equalize is disabled. In order to begin an equalize charge, the Equalize pushbutton must be pressed.
The cycle counter (charger parameter #6) increments each time a charge cycle successfully completes,unless the time spent in start current mode is less than 1 hour. When the cycle counter and the Equalize Counter option contain the same value, an Equalize charge cycle is performed, and the cycle counter is reset to 1.
The charger display shows the Equalize counter in the format E=XX.
The range is 0 to 20
The factory setting is 5.

Changing Equalize Counter

To change or view the Equalize Counter option, enter the User level and have the display contain -02-.
Press the Select pushbutton. The current setting of Equalize Counter will appear in the display. Use the Up and Down Arrow pushbuttons to change the value in the display.
Press the Select pushbutton again to save the current setting in the display to return to the User level.

When the User level adjustments are complete, press the Stop pushbutton to exit, or continue to the next option by the Up or Down Arrows.

-03- Automatic / Manual Option

The Automatic / Manual option determines if charge cycles will be performed in Automatic or Manual mode.

If this option is set to Automatic (1), the charge cycle will begin auto delay as soon as a battery is connected to the charger. The following lists what will happen when your charger is operating in Automatic mode. (Also, refer to the Automatic mode flow chart contained in this manual.)

Actual charging will begin after the time specified in Delay Start (User level option -01-) elapses.

If the Equalize Counter option (User level option -02-) is not 0, then an Equalize charge cycle will be performed as specified by that option.

If the Equalize pushbutton is pressed during a Daily charge cycle, it will become an Equalize charge cycle. If the Equalize pushbutton is pressed during an Equalize charge cycle, but before Equalize mode begins, it will become a Daily charge cycle.

A Refresh charge cycle will occur if the battery is left connected to the charger, for longer than the Refresh Wait period, after the charge cycle has completed.

If this option is set to Manual (2), the charge cycle will not begin after the battery is connected to the charger until, either the Daily or Equalize pushbutton is pressed. The following lists what to expect when operating the charger in Manual mode.

Charging will begin as soon as the Daily or Equalize pushbutton is pressed (when a battery is connected to the charger).

If the Equalize pushbutton is pressed during a Daily charge cycle, it will become an Equalize charge cycle. If the Equalize pushbutton is pressed during an Equalize charge cycle (but before Equalize mode begins), it will become a Daily charge cycle.

To begin a Refresh charge cycle (when a charge cycle has completed and the display reads OFF), press the Refresh pushbutton. The Refresh charge cycle will begin immediately.

The factory setting is 1 (Automatic).

Changing Automatic / Manual Option

To change or view the Automatic / Manual option, enter the User level and change the display to contain -03-.

Press the Select pushbutton. the current setting of Automatic / Manual will appear in the display. Use the Up and Down Arrow pushbuttons to change the Value in the display.

Press the Select pushbutton again to save the current setting in the display and to return to the User level.

When you have completed making User level adjustments, press the Stop pushbutton to exit.

FIELD TECHNICIAN LEVEL ADJUSTMENTS

NOTE: Refer to the Field Enhancement / Upgrade decal, located on the inside part of the door, to see if the charger has any custom settings.

Hold down the Select and the Refresh pushbuttons at the same time. After approximately 5 seconds, the display will read “SErc”. Release the pushbuttons. The display should contain =01=.

The Charger parameters can now be modified. Use the Up and Down Arrow push-buttons to access parameters as identified in the table contained in the Standard Settings section of Theory of Operation.

To access the parameter value indicated on the display, press the Select push-button.

To change the parameter value, use the Up and Down Arrow push-buttons.

After entering a new parameter value, press the Select push-button to save the new value and return to the previous level where you can choose another parameter to change.

NOTE: An optional “Edit” parameter is available to reset the user and service level parameters to a default flooded cell configuration. This is accomplished by decreasing the parameter from parameter #1 and setting “Edit” to 1.

WARNING: This will reset parameters to a 18 cell, 850 AH, flooded cell battery.

SERVICE LEVEL PARAMETERS

The standard charger setting is time voltage termination (charger parameter #9). When the charger is set to time voltage termination, the charger remains in start rate current (charger parameter #1) until the gassing voltage point (charger parameter #2) is reached. Then control changes to constant voltage, and maintains voltage until finish rate current (charger parameter #3) is reached. Control then reverts back to constant current control. It takes a standard period of 5 hours to get from the gassing voltage point to the end of the charge cycle , not including Equalize.
The optional proportional termination method (charger parameter #9) follows the same I-E-I path, but records the amount of time in start rate current. The amount of time spent in finish rate current is based on the time spent in start rate current. The amount of time in finish rate current is calculated by multiplying a standard 0.4 times the start rate time. The proportionality is under software control and can be changed from the front panel (charger parameter #14).
Standard start rate current is 0.16 (16 amps / 100) times the amp hour rating on the charger nameplate or of the battery, whichever is smaller.
Standard finish rate current is 0.045 (4.5 amps / 100) times the amp hour rating on the charger nameplate or of the battery.

Charger Parameters

Display Number	Charger Parameter	General Information
1	Start Rate	Multiply the AH rating on the charger nameplate by 0.16. WARNING: The start rate should never be set above the maximum DC current indicated on the charger nameplate rating.
2	Gassing Point	Factory set to 2.38 v/c. In a cold environment, the gassing voltage point will need to be higher. In the charge cycle, this point indicates the end of start current mode and the beginning of constant voltage mode.
3	Finish Rate	Found by multiplying **BATTERY** AH by 0.045. In the charge cycle, this is the current rate during finish current mode.
4	Charger AH Rating	Set to the charger nameplate rating or less, depending on the battery. May effect volts per cell reading. Cable compensation has been internally set for the charger nameplate AH rating and 8 ft of battery cable.
5	Charger Cell Size	Set to the charger's nameplate cell rating.
6	Cycle Counter	Increments each time a charge cycle successfully completes. If less than 1 hour was spent in Start Current mode, then the cycle counter will not be incremented. The charger's display shows the cycle counter in the format C = XX. If the charger is set for Automatic Equalize (User level options -02- and -03-), the charger will automatically perform an equalize charge cycle when the cycle counter equals the equalize counter. After the equalize charge cycle is performed, the cycle counter is reset to one. The equalize counter remains the same. Select a number = a day of the week (Monday = 01 thru Sunday = 07) The range is C=1 to C=99. The factory setting is C=1.
7	Refresh Wait Period	Usually set to 12:00 (12 hours). Time (after a charge has completed, and the battery is left connected to the charger) before a refresh charge will start. The recommended range is 6:00 - 18:12. The factory setting is 12 hours.
8	Refresh Charging Time	Usually set to 00:20 (20 minutes). Time spent doing a refresh charge: The range is 00:00 - 3:00. The factory setting is 20 minutes.
9	Method of Termination	Specifies how the charge cycle will terminate.: 1 = Proportional; 2 = Time voltage. If this parameter is set to 1, charge termination will occur when time spent in finish current mode = 40% (factory setting) of the time spent in start current mode. If this parameter is set to 2, charge termination will occur 5 hours (factory setting) after the gassing voltage point is reached. If this is an Equalize cycle, the charging time will be the termination time specified above plus 3 hours.

Display Number	Charger Parameter	General Information
10	Charge Time Limit	The time in start current mode. Factory set to 06:00 (6 hours). If a battery does not accept normal charge within the time specified by this timer, the charge cycle will be terminated. NOTE: Charge Time Limit = Maximum time in start current mode. NOTE: Charge Time Limit divided by two = time limit in constant voltage mode. NOTE: Charge Time Limit multiplied by 2 = time limit on total charge cycle. The range is 00:00 - 18:12. The factory setting is 6 hours.
11	Transformer Code Number	See the table following for code numbers. If your code is not listed, use the default setting, 1.
12	Cool Down Waiting Time	Cool down time after the charge cycle has completed, but before battery is ready to use. NOTE: While in cool down, the charger cannot be restarted. The display will contain COOL during this time period. The range is 00:00 - 18:12. The factory setting is 00:00 (no cool down time)
13	Battery Type	Specifies flooded or sealed battery charging. FLOd = flooded cell SEAL = sealed cell Presets the gassing point, finish rate current, termination method, time voltage limit, and the charge time limit parameters to the typical configurations of the selected type of battery. These configurations are as follows: Flooded cell — Gassing point: 2.38 v/c; Finish rate current: 4.5 A/100 A-H; Termination method: Time voltage; Time voltage limit (daily): 5:00 hours; Charge time limit (equalize): 6:00 hours Sealed cell — Gassing point: 2.37 v/c; Finish rate current: 2A/100 A-H; Termination method: Time voltage; Time voltage limit (daily): 6:00 hours; Charge time limit (equalize): 7:30 hours
14	Proportional Time Factor	This parameter adjusts the percentage rate of the proportional time termination mode. Proportional mode selects the time the charger runs in finish rate based on a percentage of the time spent in start rate. This parameter is only used in proportional time termination mode. The range is 0 - 100. The factory setting is 40 (40%).
15	T-V Time Limit	Selects the time that the charger runs after the 80% point has been reached. This parameter is used in time voltage termination mode only. The range is 0:00 - 12:00. The factory setting is 5:00 (5 hours).
16	Time After Gassing	Selects the time that the charger runs after the 80% point has been reached. This parameter is a termination timer and is only used when parameter 13 is set to SEAL. The factory setting is 4:00 (4 hours)
17	Time after Finish	Selects the time that the charger runs after the Finish Voltage of 2.53 vpc has been reached. This parameter is a termination timer and is only used when parameter 13 is set to SEAL. The factory setting is 2:00 (2 hours)
18	Finish Voltage	This voltage is factory set to 2.53 volts per cell. This parameter is only used when parameter 13 is set to SEAL. Once finish rate is reached, battery voltage will climb to this set point. Battery voltage will be held constant at 2.53 v/c until parameter 16 or 17 above is satisfied.

TRANSFORMER CODES

REFER TO THE FIELD ENHANCEMENT / UPGRADE DECAL FOR THE FACTORY SET TRANSFORMER CODE.

If the transformer is replaced contact the technical support.
The following table represents a guideline for the reference transformer code.

MODEL	CODE NUMBERS					MODEL	CODE NUMBERS			
	B-model	J-model	D-model	E-model			B-model	J-model	D-model	E-model
S06-680	19	-	-	-		S18-1700	21	20	25	-
S12-550	18	-	-	-		S18-2000	21	-	-	-
S12-680	16	16	22	-		S24-200	18	-	-	-
S12-850	16	19	20	-		S24-550	18	-	24	23
S12-950	-	-	-	-		S24-680	18	19	36	-
S12-1050	18	-	-	-		S24-850	23	25	-	-
S12-1200	18	20	-	-		S24-950	23	23	27	-
S12-1500	21	-	-	-		S24-1050	21	21	18	29
S18-550	16	-	-	-		S24-1200	21	26	20	-
S18-680	18	20	-	-		S24-1500	21	21	-	-
S18-850	20	-	26	26		S40-550	23	23	-	-
S18-950	19	24	26	-		S40-680	24	23	-	-
S18-1050	17	22	25	-		S40-850	22	-	-	-
S18-1200	23	22	25	-		S40-950	-	-	-	-
S18-1500	22	20	25	-		S40-1050	19	-	-	-

FIELD CALIBRATION PROCEDURE

The Field calibration procedure MUST BE DONE to calibrate the charger current and volts per cell (v/c).
NOTE: The National Parts Center has meters that are appropriate for performing calibration settings. NPC carries a clamp on DC ammeter and 2 types of Fluke hand held meters: DVM (Digital Volts Meter) and DMM (Digital Multi Meter).

The following modes can be calibrated:

#01≡01≡ Low current
#03≡03≡ Hi current.
#02≡02≡ Low v/c
#04≡04≡ Hi v/c

Voltage or current can be calibrated independently.

Preparation

To perform the calibration procedure, the following Equipment is required:

A charged battery.
A set of jumper cables with alligator clips.
A good quality meter.

Verify that the following are set as indicated:

The AC power is ON.
The battery is NOT connected.
Set charge parameters for the charger being calibrated.
The cell size jumpers (JP4) are properly set for this type of charger.
The shunt element jumpers (JP5) are properly set for this type of charger.

Refer to the section Problem Identification and Troubleshooting for the PCB diagram showing jumper location and shunt element requirements.

Beginning the Calibration Routine

Hold down the Select and the Equalize pushbuttons at the same time. After approximately 5 seconds, the display will read “CALb”. Release the pushbuttons. In Calibration mode, the display will contain ≡01≡.

Calibrating the Low Current Setting Mode (#01)

Follow these steps before trying to calibrate Mode #01.

Connect a good battery to the charger. The battery can be in any condition - fully charged to fully discharged.

Connect the meter to measure the current at the battery (load).

If the charger display contains ≡01≡, press the Select pushbutton to activate mode #01.

If the charger display does not contain ≡01≡, use the Up or Down Arrow pushbuttons until ≡01≡ is in the display. Then press the Select pushbutton to activate mode #01.

WARNING:	Be sure to have a load connected to the charger.

About 5 or 10 seconds after the Select pushbutton is pressed, the charger will begin to output a small amount of current; about 2% of the Ampere Hours (AH) of the charger.

When the meter reading becomes stable, change the value on the charger display to the current reading on the meter. Use the Up and Down Arrow pushbuttons to change the value in the display.

Press the Select pushbutton to save the data and exit this mode.

Calibrating the High Current Setting Mode (#03)

WARNING:	To calibrate this mode do not apply all of the cells of a fully charged battery. The charger is not capable of delivering start rate current over 2.45 v/c.

In most cases, the voltage should be read in the charger, at the positive and negative cable.

Follow these steps before trying to calibrate this mode:

Connect to the charger a battery that is more than 20% discharged or to a group of cells that will keep the charger voltage near or below 2.45 v/c.

Connect a meter to measure current at the battery.

Press the Up or Down Arrow pushbuttons to go to ≡03≡.

Press the Select pushbutton to activate the mode.

A few seconds after the Select pushbutton is pressed, the charger will begin to climb to a high current setting.

When the meter reading becomes stable, set the display to the current reading on the meter. To change the value in the display, use the Up and Down Arrow pushbuttons.

If the value in the display requires change more than 10%, check all of the shunt connections for tightness or corrosion.

The values measured at the high current point will be approximately 10 times the values measured at the low current point.

Press the Select pushbutton to save the data and exit this mode.

Calibrating the Low Voltage Setting Mode (#02)

Follow these steps before trying to calibrate Mode #02.

Connect a group of cells that equal 1.0 to 2.0 volts per cell (v/c) to the charger.

Connect a good quality meter to the positive and negative terminals **IN THE CHARGER** to measure voltage.

Press the Up or Down Arrow pushbuttons to go to ≡02≡.

Press the Select pushbutton to activate Mode #02.

WARNING:	Be sure to have the proper load connected to the charger.

Wait 5 to 10 seconds for the charger to stabilize if the reading is changing.

When the meter reading stabilizes, calculate v/c.. This is done by dividing the voltage the meter shows by the number of cells indicated on the charger nameplate.

Change the value in the display so it contains the v/c calculated. Use the Up and Down Arrow pushbuttons to do this.

Example: The charger nameplate rating is 18 cells. The charger is connected to a group of 16 cells. The meter reads 34.2V. 34.2 divided by 18 equals 1.90. Set the display to 1.90.

Press the Select pushbutton to save the data and exit this mode.

Note: the charger will only output current if less than 1.00 volt/cell is applied to the charger.

Calibrating the High Voltage Setting Mode (#04)

Follow these steps before trying to calibrate this mode.

Connect a battery or a group of cells that can reach 2.5 v/c to the charger.

NOTE: Do NOT use a partially discharged battery. The charger will attempt to force the battery to 2.5 v/c by means of a high current.

Connect your meter to the Positive and Negative terminals in the charger to measure voltage.

Press the Up or Down Arrow pushbuttons to go to ≡04≡.

Press the Select pushbutton to activate the mode.

After the Select pushbutton is pressed, the charger will output current and try to bring the battery voltage up to 2.5 v/c.

When the meter reading becomes stable, calculate v/c. This is done by dividing the voltage the meter shows by the number of cells indicated on the charger nameplate.

Change the value in the display so it contains the v/c calculated. Use the Up and Down Arrow pushbuttons to do this.

Press the Select pushbutton to save the data and exit this mode.

Note: The charger will only output current if less than 2.50 volt/cell is applied to the charger.

Ending the Calibration Routine

Press the Select pushbutton to save the data from the last mode you calibrated.

Press the Stop pushbutton to exit the Calibration routine.

WARNING:	Do NOT go back and check any of the settings. The system will enter random data rather than what was just entered. This random data will cause charger performance to be less than the optimum that can be obtained from a careful calibration.

RECHARGE CHARACTERISTICS

When a charge cycle begins, constant current is applied to the battery (start current mode). This constant current, called start rate current, is specified in Charger parameter #1.
When the gassing voltage point (80% charge voltage of 2.38 volts/cell) is reached, the charger stops applying constant current, and starts applying constant voltage (constant voltage mode).

GASSING VOLTAGE POINT NOT REACHED

If the gassing voltage point is not reached during the time allotted (specified in Charger parameter #10), which is factory set for 6 hours), the override timer will time out and shut down the charger. The charger's display will show a fault code that indicates a defective or mismatched battery or wrong setting, 5.5.5.5.

GASSING VOLTAGE POINT REACHED

When the gassing voltage point is reached, the override timer resets and timing begins again for constant voltage mode.
During constant voltage mode, the current tapers down to approximately 4.5 amps per 100 AH. At this point, the charger stops applying constant voltage and returns to applying constant current (finish current mode). This constant current, called finish rate current, is specified in Charger parameter #3.

FINISH CURRENT MODE NOT REACHED

If the finish current mode is not reached during the time allotted (specified by 1/2 of Charger parameter #10), the override timer will time out and shut down the charger. The charger display will show a fault code of 6.6.6.6.

FINISH CURRENT MODE REACHED

If the finish current mode is reached, the charger will continue charging until termination time is reached.

EQUALIZE MODE

If this is an Equalize charge cycle, the charger will complete the finish current mode, and then enter Equalize mode where it will equalize all the cells in the battery. It is recommended that every fifth or sixth charge cycle be an equalize cycle (check with battery engineering).
During Equalize mode the charger applies constant current at the same rate as the current in finish current mode. The Equalize mode adds 3 hours to a daily charge cycle.

REFRESH MODE

Refresh mode will be entered after the charge cycle has completed, if the battery is left connected to the charger for the period of time specified in Charger parameter #7 (Refresh Wait period, which is factory set for 12 hours). A refresh charge assures that the battery is fully charged.

During Refresh mode the charger applies constant current at finish setting. The time spent in Refresh mode is specified in Charger parameter #8 (Refresh Charging Time, which is factory set for 20 minutes).

CHECKING THE RECHARGE CHARACTERISTICS

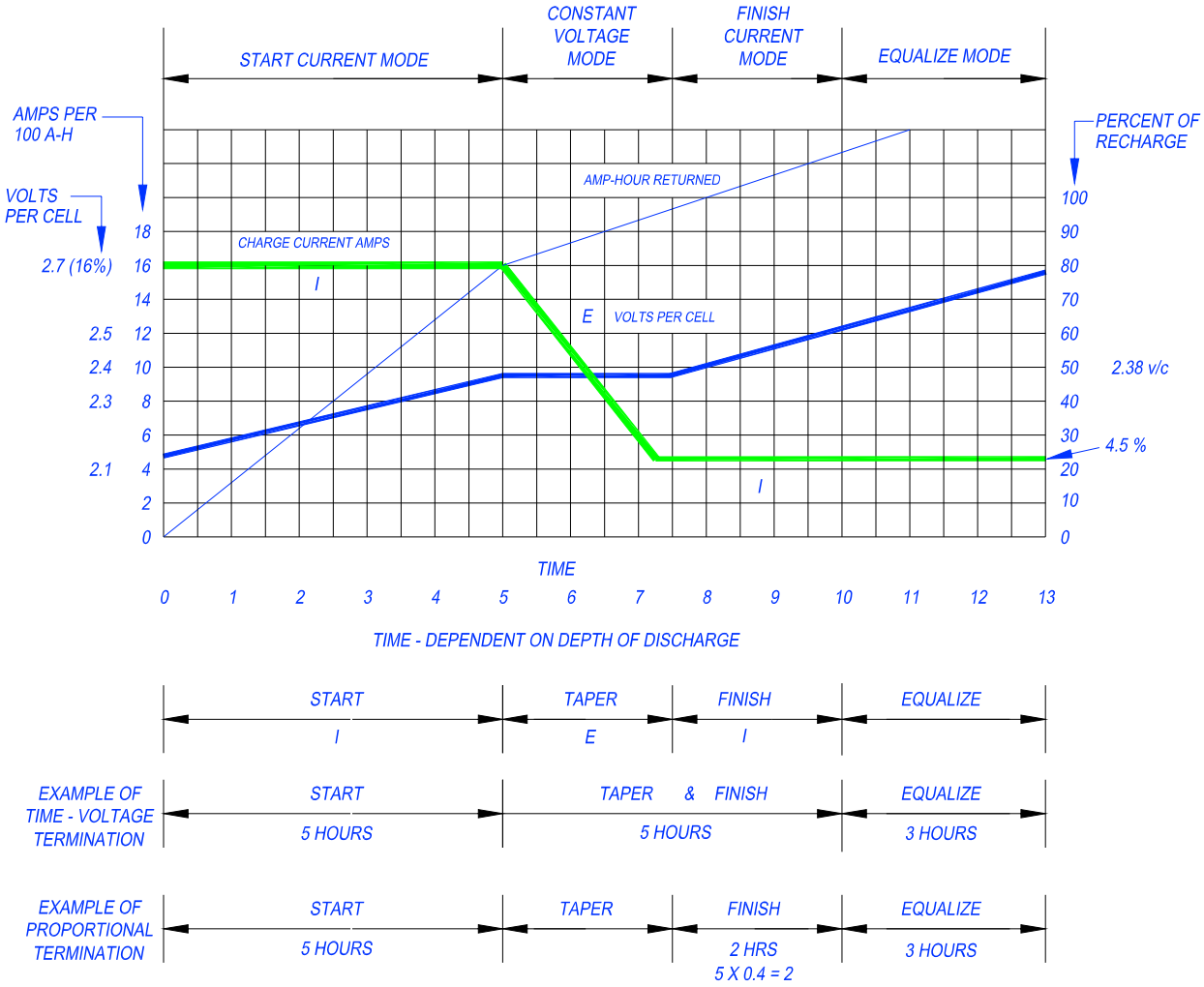
You can check the battery voltage during start current mode on a **discharged** battery. The battery voltage should gradually increase to 2.38 volts/cell (v/c) with the charging current at 16% of the battery and/or charger nameplate rating.

Example: If you are using a 550 AH charger, the charging current during start current mode will be 16% of 550 which is 88 amperes.

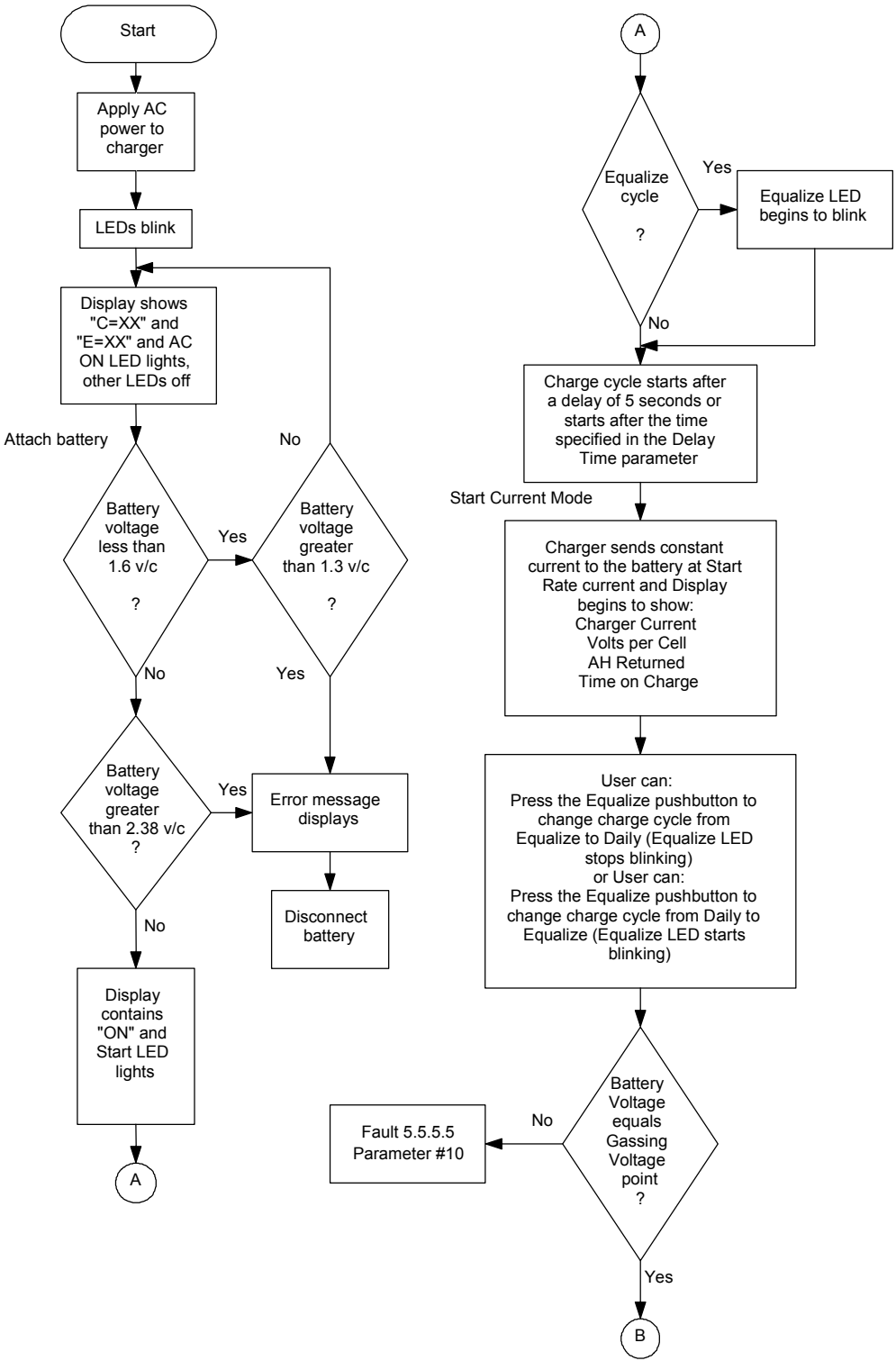
The output voltage terminals can be checked during constant voltage mode. The battery voltage should be steady at 2.38 v/c ± 1%, and the charge current should gradually decrease.

The battery voltage can be checked during finish current mode. The battery voltage should measure at least 2.38 v/c at a constant current of 4.5% of the charger nameplate rating.

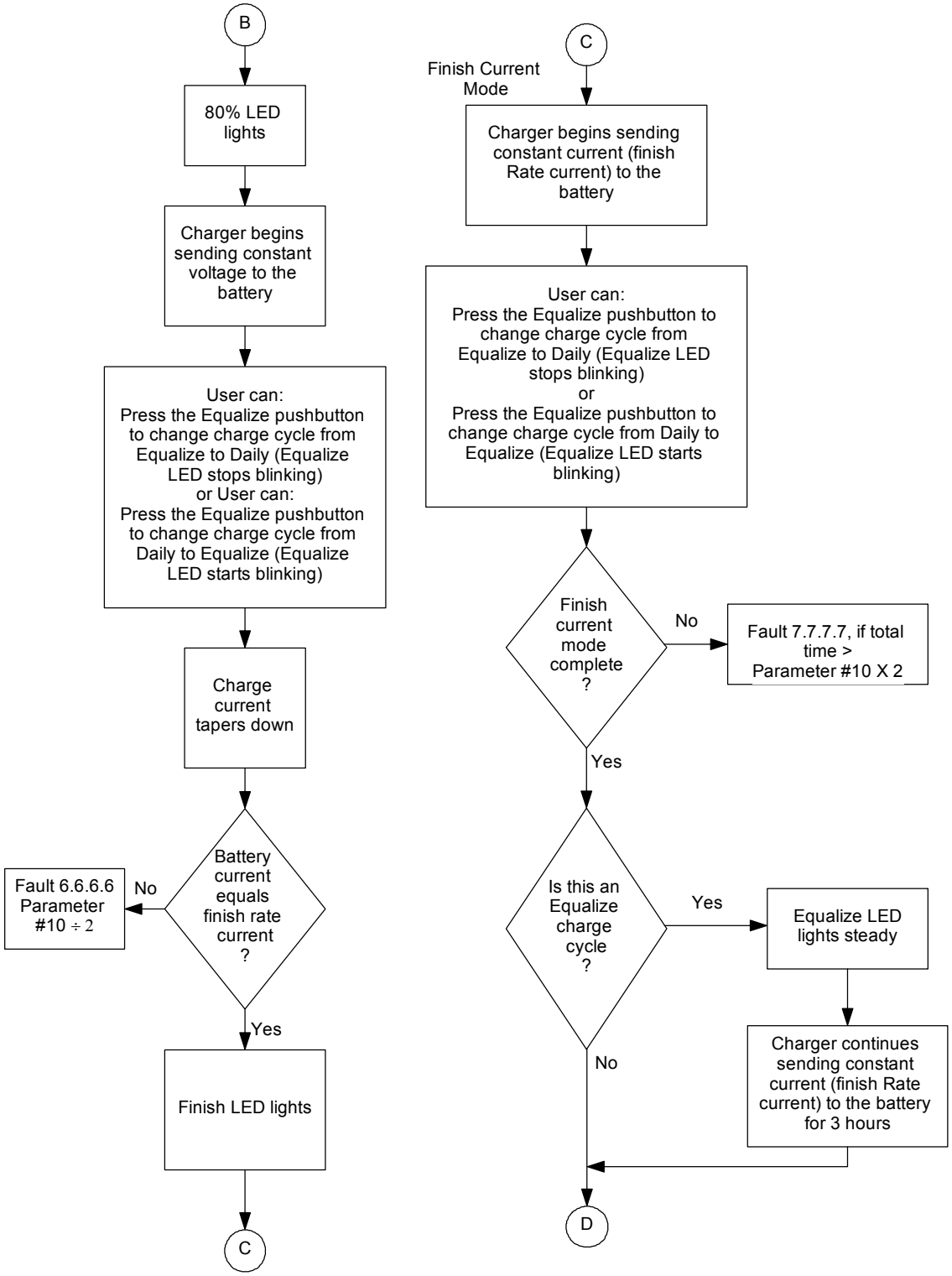
Recharge Characteristics, Flooded Cell



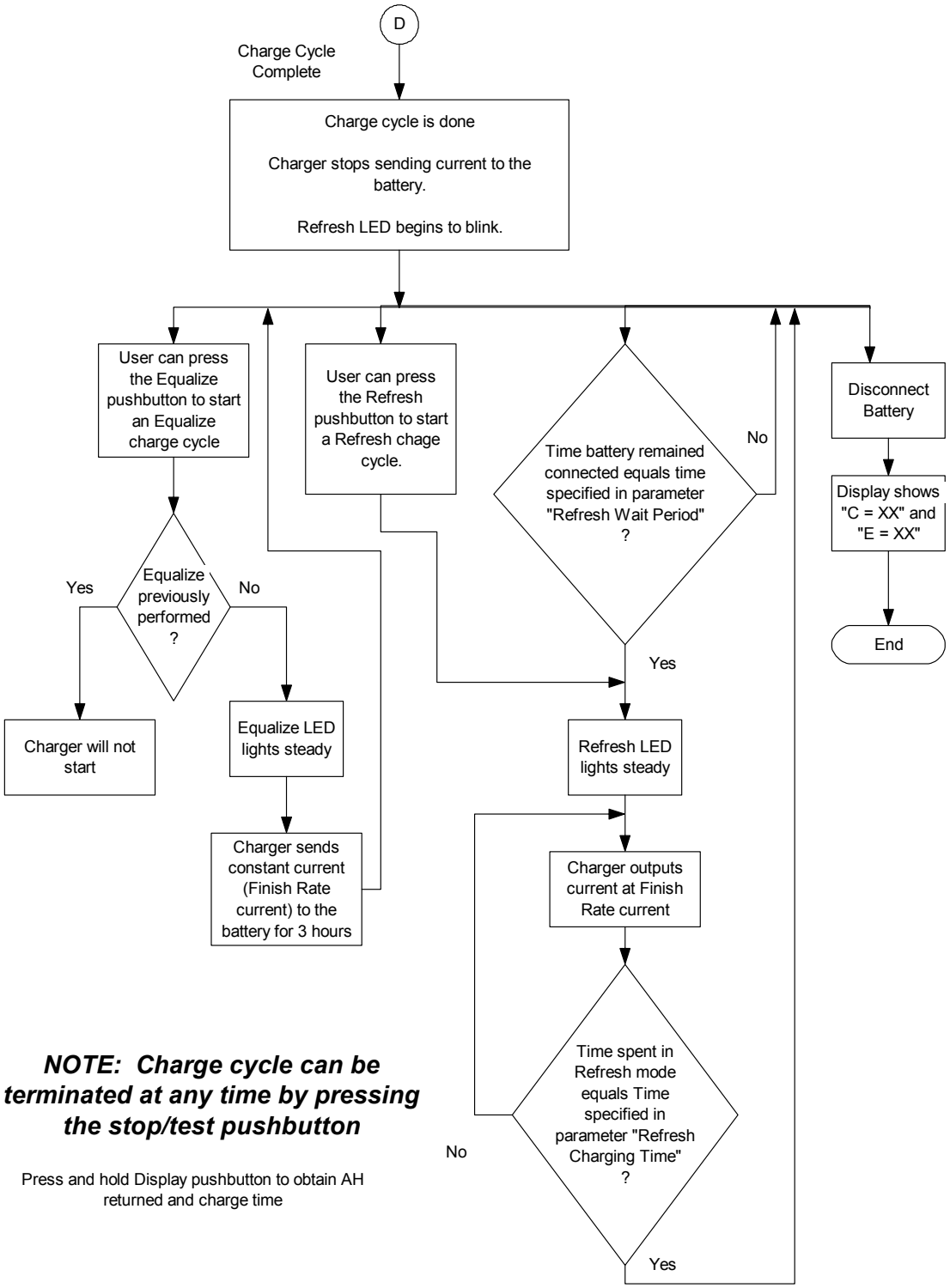
Charge Cycle in Automatic Mode



Charge cycle in Automatic Mode (con't)



Charge cycle in Automatic Mode (con't)



NOTE: Charge cycle can be terminated at any time by pressing the stop/test pushbutton

Press and hold Display pushbutton to obtain AH returned and charge time

BASIC TROUBLESHOOTING PROCEDURE

1. Visually inspect all connections and components for signs of overheating, loose connections, improper connections, or damage. Be sure to include the transformer terminal strip connections.

2. Verify that AC voltage is present at the proper value at the bottom of all three AC input fuses. Fuse values are listed in this manual.

3. Verify that the transformer AC taps are in their proper positions. Refer to the Voltage Conversion section.

4. Measure and verify the transformer voltages. All values should be within 10% of those in the following tables. Readings of the phases should be within 1.5% of each other, depending on the line variations. For example, the value measured between terminals 2 and 3 for Phase A, Phase B, and Phase C must all be within 1.5% of each other. Also, measurements between terminals 1 and 2 should be the same as measurements between terminals 4 and 5, measurements between terminals 2 and 3 should be the same as measurements between terminals 5 and 6, etc.

NOTE: If a transformer is replaced, make absolutely sure that power wires 9A, 9B, and 9C and control wires 7A, 7B, and 7C are connected to the proper locations per the schematic wiring diagram.
NOTE: Steps 4, 5, and 6 determine whether the transformer and associated wiring is functioning properly.

Terminal Board Voltages

Terminals (on each phase)	AC Line Voltages * (208/240/480 Volts; 60 Hz)
1-2 4-5	208 ± 10%
2-3 5-6	32 ±10%
1-3 4-6	240 ± 10%
* NOTE: These values are dependent upon the actual line voltage.	

5. Measure and verify the voltages at the bottom of fuses F5, F6, F7, F8. These fuses are located in the upper-left corner. The leftmost fuse is F5. All values should be within 10% of those in the following table:

Fuse Voltages (F5 - F8)

Connect bottom of these fuses	AC line Voltage * (volts)
F8 to F7	10 ± 10%
F8 to F6	10 ± 10%
F8 to F5	10 ± 10%
* NOTE: These values are dependent upon the actual line voltage.	

6. Measure and verify the voltages of the heatsinks. All values should be within 10% of those in the following table.

SCR/Diode Block Input Voltages

Measure between These SCR/Diode Blocks	AC Line Voltage
Left SCR/Diode Block to center SCR/Diode Block	2.35 v/c-AC +/- 10%
Left SCR/Diode Block to right SCR/Diode Block	2.35 v/c-AC +/- 10%
Center SCR/Diode Block to right SCR/Diode Block	2.35 v/c-AC +/- 10%

NOTE: These values are dependent upon the actual line voltage.
NOTE: 2.35 v/c-AC multiplied by the number of cells = total AC voltage.

7. If a DC fuse has opened, check:
   Battery and charger connector polarity
   Loose DC assembly
   Shorted SCR/Diode Blocks

8. If an AC fuse has opened, check:
   Transformer taps
   Shorted SCR/Diode Blocks
   SCR/Diode Block balance*

*Check balance with a clamp on AC ammeter. All currents should be within 10% of each other. If any SCR/Diode Block is zero, an open component or loose connection may exist.

9. Measure and verify the voltages at connector J1 (Refer to PCB diagram) All values should be within 10% of those in the following table.

Wire Voltages of Connector J1

Wires at J1	AC Line Voltage * (volts)
X1 to X2	10 ± 10%
X1 to X4	10 ± 10%
X1 to X6	10 ± 10%
* NOTE: These values are dependent upon the actual line voltage	

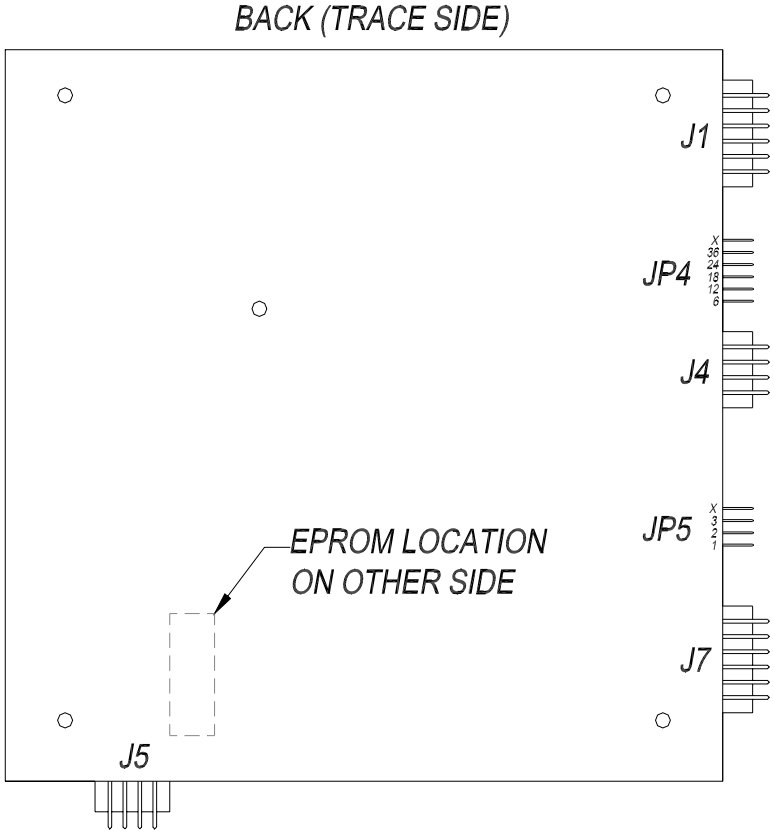
10. Verify that the cell size jumpers (JP4) are in the correct position, consistent with the charger's nameplate. Refer to the diagram following this section for location of jumpers.

11. Verify that the shunt size jumpers (JP5) are in the correct position (position 1 = 150 amp shunt, position 2 = 300 amp shunt, and 3 = 450 amp shunt). See the PCB diagram for jumper locations

12. Verify that the battery has the proper voltage rating and the proper ampere hour (AH) rating for your charger.

13. Verify that when a battery is connected, full battery voltage appears at PC board connector J4, wires Y4 and Y3 with Y3 positive.

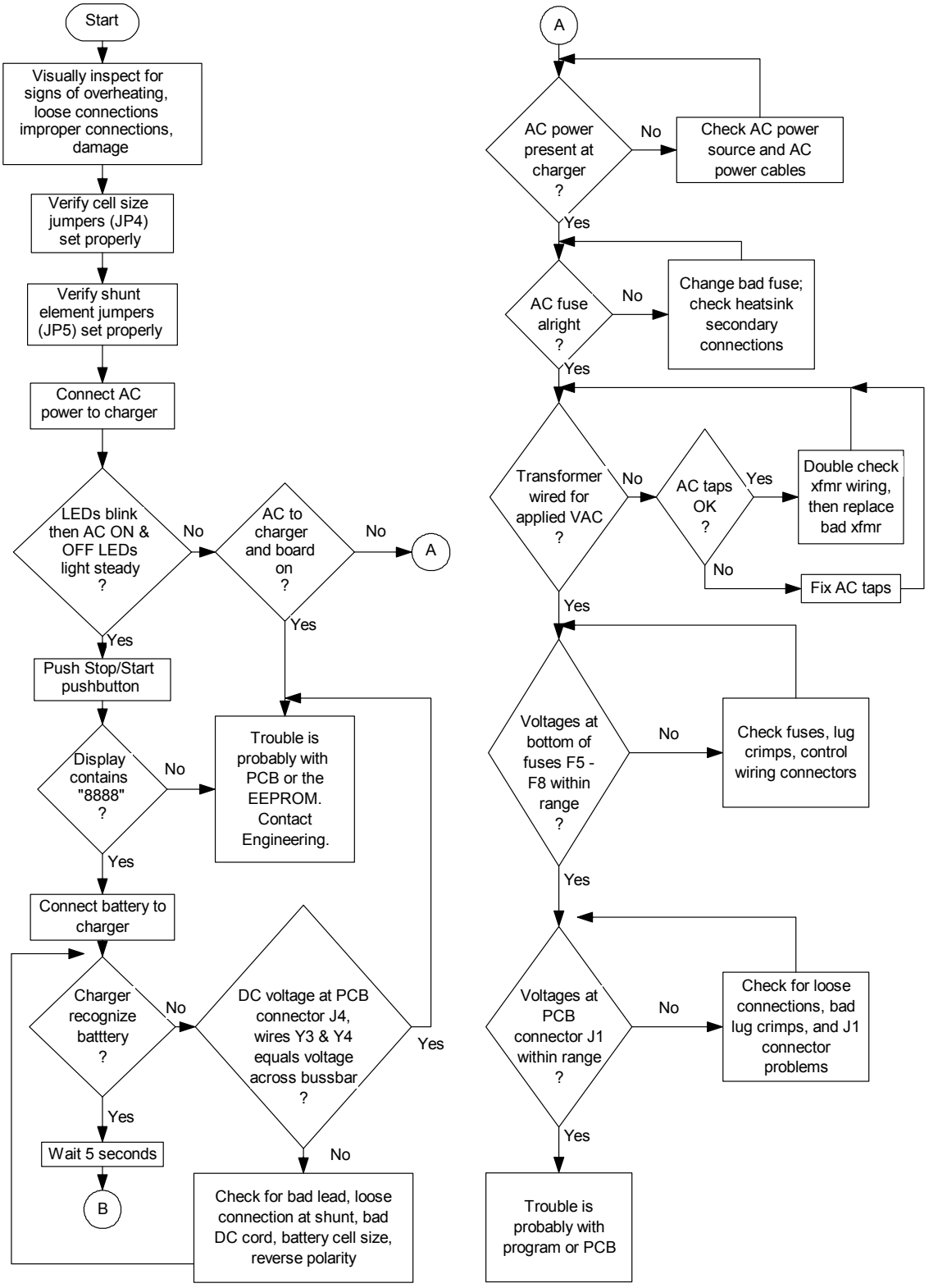
14. With the charger running, verify that the DC voltage at PCB connector J4, wires Y1 and Y2, is the same as the DC voltage across the shunt (10-75 mV depending on the DC current output).



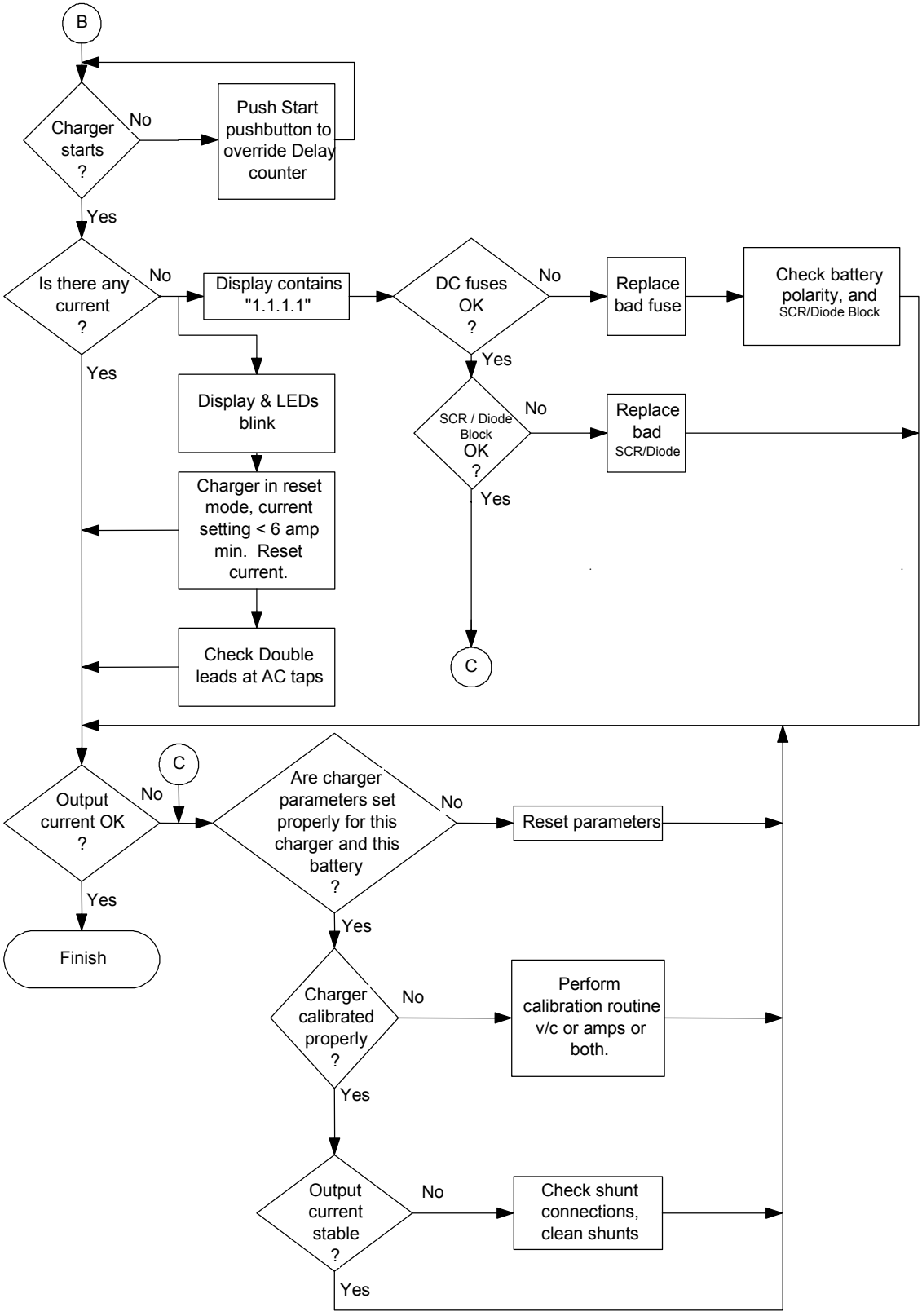
15. After a charge cycle successfully ends, disconnect the battery, and measure the voltage across the positive and negative charger terminals. This should measure less than 1 v/c. If it measures a greater voltage, a SCR/Diode Block may be leaky. Test your SCR/Diode Blocks as described in the Testing Components section.

The power circuitry is functioning properly if no problems were found when you went through the above steps. If problem is still present after going through these steps, look carefully for loose connections. If there is still a problem, then the trouble is probably in the PCB or program.

Troubleshooting Flowchart



Troubleshooting Flowchart (con't)



SYMPTOMS, SUGGESTIONS, AND REMINDERS

1. If the DC fuse is continually opening:
   a. One of the SCR/Diode Blocks may be defective.
   b. The charger may have loose shunt wires.
   c. The charger may have battery polarity reversed.
   d. Verify that the shunt element jumpers (JP5) are in the proper position.
   e. Verify that the start rate current is set properly (charger parameter #1).
   f. Worn connectors on DC cables.
2. If the charger is faulting 5.5.5.5; 6.6.6.6; or 7.7.7.7; and charger parameter #10 (charge time limit) is set to 6 hours: Is the battery > 125% of nameplate AH ? Try changing charger parameter #10 to a larger number.
3. If, every time a charge cycle begins, there is a phase loss as the charger tries to start up and then the charger appears to correct itself (LEDs blinking, indicating a fault detection, then a fault correction):
   a. The 2 lugs at the bottom of each input fuse may not be secured properly under the screws.
   b. The transformer double wires (for example, wires #2 and #5) may not be properly inserted into the AC terminal blocks.
4. To protect from overcharging, be sure that:
   a. Start rate and finish rate currents are set properly (charger parameters #1 and #3).
   b. Gassing voltage point (charger parameter #2) is not set too high, should be set to 2.38 volts per cell.
   c. Time limits (charger parameter #10) are set properly.
   d. Refresh (charger parameter #7) is not too frequent > 4 to 1 ratio ≤ 1 hr. charge.
5. To protect from undercharging, be sure that:
   a. Finish rate current (charger parameter #3) is not set too low (finish rate = 4.5% rated capacity of the battery).
   b. Start rate current (charger parameter #1) is set to your charger's nameplate rating or the AH of the battery X .16, whichever is less!!
6. To protect from overcharging:
   a. If the AH rating of the charger is greater than the AH rating of the battery, the start rate current (charger parameter #1) should be reduced to the proper value for this battery.
   b. Finish rate (charger parameter #3) and start rate (charger parameter #1) currents must be adjusted downward for the AH rating of that battery. (Finish rate = 4.5% rated capacity of the battery, start rate = 16% rated capacity of the battery).
7. If the AH rating of the battery is greater than the AH rating of the charger:
   a. Be sure that the start rate current (CHR parameter #1) does not exceed the charger's nameplate rating.
   b. Finish rate current (CHR parameter #3) will need to be adjusted upward for the AH rating of that battery. (Contact technical support before performing an upward adjustment on the finish rate current.)
8. To stop or pause a charge:
   Push the Stop push-button, and then disconnect the battery. To only pause the charge, leave the battery connected, the charge will continue from where it left off when the charger is started again.
9. During an AC power failure:
   Key information concerning the charge cycle is saved electronically. When power returns, this information is automatically retrieved, and if a battery is connected to the charger, charging automatically continues from where it was interrupted, protecting the battery from being overcharged. There will be a "random-delay" before restart: 30 seconds to 10 min.
10. If the battery is disconnected during a charge cycle:
    The charger turns off, and fault code 1.1.1.1 will usually appear on the display.
11. To stop an equalize cycle (when the Equalize LED is lighting steadily):
    Push the Stop push-button and unplug the battery.
12. DC cables that are longer than the 8 feet standard will cause a voltage drop of about 1/2 volts per 10 feet at start rate. Use the next larger size of cable for every additional 10 feet of cable used.

LOAD HOG CONTROL BOARD

Two types of control boards are available for 3 phase SCR chargers. The Operating Instructions are different depending on the control board. In addition, settings are referred to **Flooded Cell** typed batteries, unless otherwise defined and marked with **Sealed Cell** settings. Operations of the PCB remain the same for either Flooded or Sealed Cell, within each type of control board.

NORMAL CHARGER OPERATION

(LT2 and LTC2 are factory set for Flooded. And SLT2 and SLTC2 are factory set for Sealed).

Reference the following flowchart for a Charge Cycle in Automatic Mode.
When a battery is connected to the charger, the charger goes through an examining period, and determines the battery cell size to begin normal charging. The charger's control circuitry measures the battery's voltage to determine if the battery is within the charging range.

In LTC with line contactor, the control circuitry will close the input contactor, energizing the main transformer.

The control circuitry then begins Constant-Current control by measuring the voltage across the shunt. This measurement is used as the current feedback signal for controlling the phase angle at which each of the 3 SCR/Diode Blocks are gated on. The higher the feedback signal, the more the SCR/Diode Blocks are retarded, and the shorter the SCR gate pulse in order to maintain current. Conversely, the lower the feedback signal, the more the SCR/Diode Blocks are advanced, and the longer the gate pulse in order to maintain current control. Loss of the feedback signals can cause one of several faults described in section Fault Messages.

A similar operation occurs during Constant-Voltage control. When the Gassing-Voltage (80%) point is reached, Constant-Voltage control begins, and the voltage across the battery terminal is measured. This measurement will be the new feedback signal, which is used to control the phase angle at which each SCR is gated on.

When Finish-Rate current is reached, Constant-Current control resumes, but at a lower current level.

In LTC with line contactor, after the charge is completed, the AC input contactor will open, de-energizing the main transformer.

The PC board will remain powered as long as AC input power is present.

FRONT CONTROL PANEL

The front control panel consists of a 16-digit display, 5 LEDs (Light Emitting Diodes), and 5 push-buttons.

Push-buttons

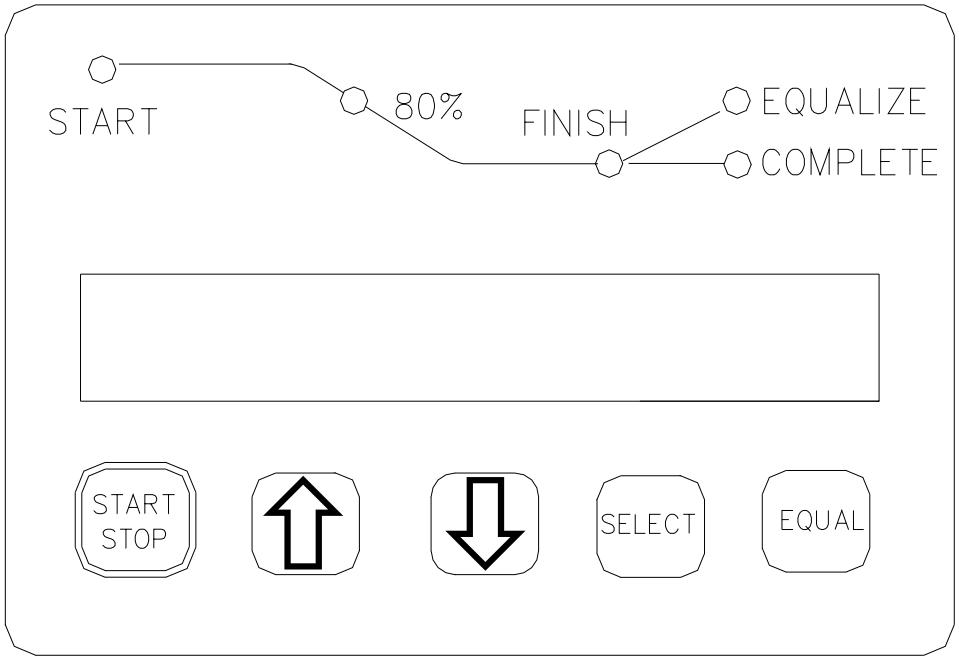
Push-button	Description
Start/Stop	Starts or restarts a Daily charge cycle when the charger is in Manual mode. In Automatic mode, it can change an Equalize charge cycle to a Daily charge cycle. If the 3 hour Equalize mode has begun, the charge cycle cannot be changed to a Daily charge cycle. Interrupts a charge in progress. The interrupted charge can be manually restarted within 1 hour (factory default setting of Program-Level parameter PAUSTIME). If the battery has remained connected to the charger for 1 hour (factory default setting of PAUSTIME) the charger will automatically restart. If a battery with a voltage outside of the acceptable range (1.6 v/c to 2.4 v/c) is connected, pressing this button for more than 5 seconds will start the charger, and the charger will attempt to charge the battery. If the battery accepts charge current, the charge cycle will continue; if not, the attempted start will be aborted.
Up-Arrow	Scrolls through the displayable parameters or menu selections, and when modifying a parameter, increases the number shown in the display. If pressed and held while a charge is in progress, causes the value currently in the display to remain displayed. The value will continue to display for a few seconds after the push-button is released.

Push-button	Description
Down-Arrow	Scrolls through the displayable parameters or menu selections, and when modifying a parameter, decreases the number shown in the display. If pressed and held, while a charge is in progress, causes the value currently in the display to remain displayed. The value will continue to display for a few seconds after the push-button is released.
Select	Enters the User Level parameter menu when not in a charge cycle. Selects the charge parameter(s) to be changed. It is also used to save the change and exit the Parameter Selection mode.
Equal	Selects or deselects an Equalize charge cycle or converts a Daily charge cycle to an Equalize charge cycle. In Manual mode, it starts an Equalize charge cycle, or changes a previously started Daily charge cycle to an Equalize charge cycle. In Automatic mode, it can change a Daily charge cycle to an Equalize charge cycle or vice versa. If the 3 hour Equalize mode has begun, the charge cycle cannot be changed to a Daily charge cycle. In Parameter-Selection mode, it is used to exit Parameter-Selection mode without saving the change made to a parameter.

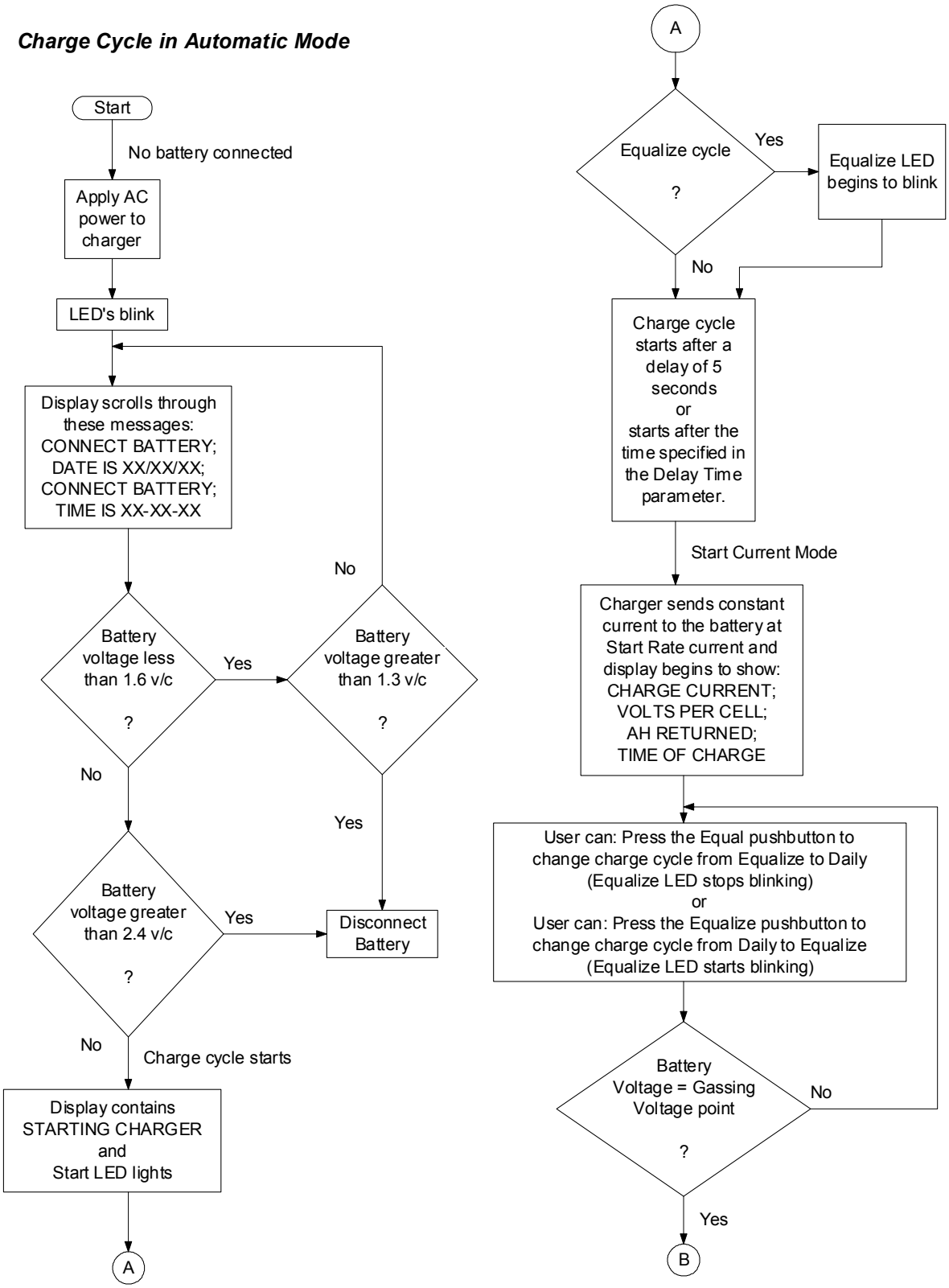
LEDs

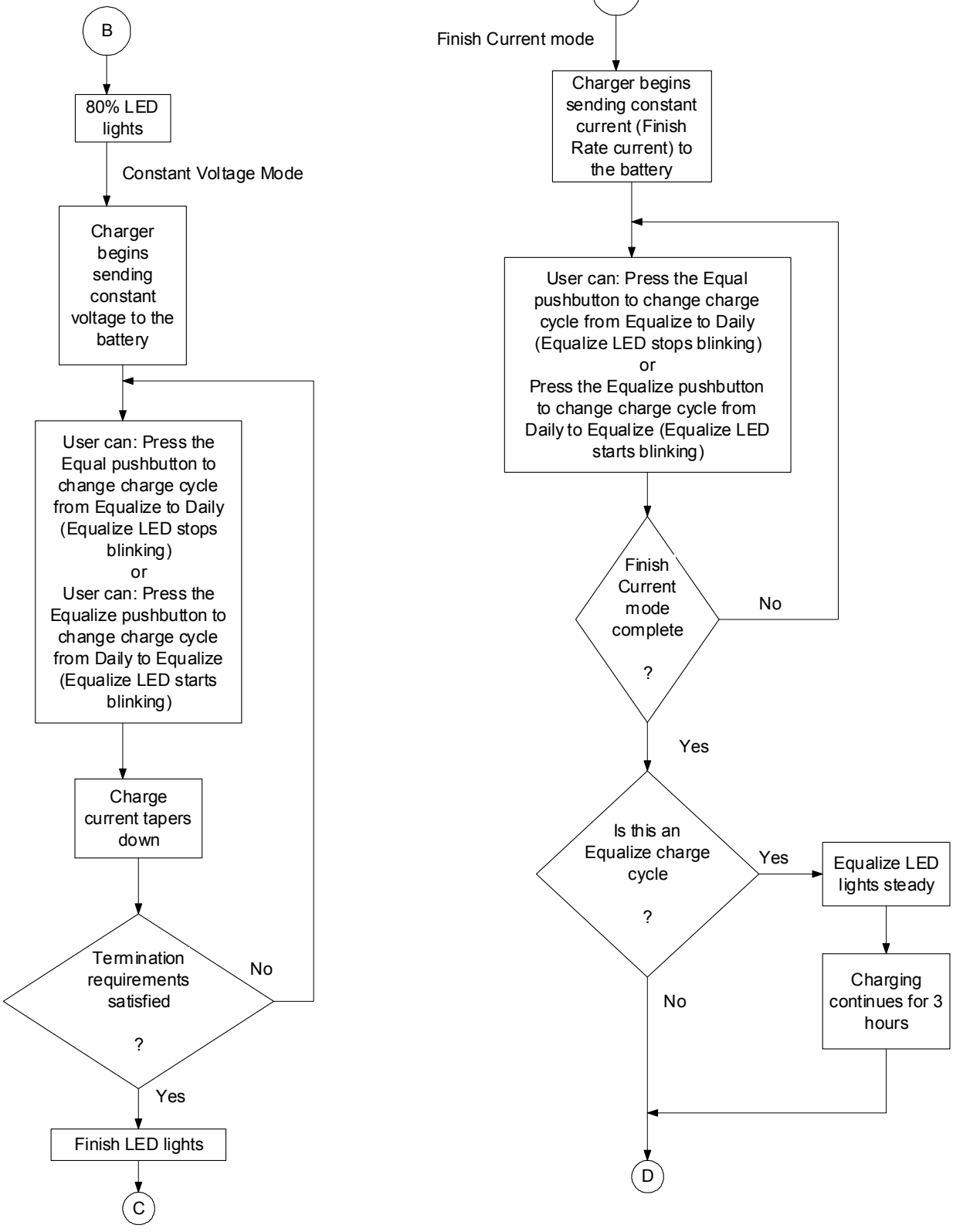
LED	Description
Start	Lights and remains on when a charge cycle begins.
80%	Lights and remains on when the Gassing-Voltage point is reached.
Finish	Lights and remains on when the charger enters Finish-Current mode.
Equalize	Blinks if a charge cycle is an Equalize charge cycle. Lights steady when the 3 hour Equalize mode begins. Lights steady during a Refresh charge cycle. Turns off when the Refresh charge cycle is complete.
Complete	Lights when the charge cycle has completed. If there is an equalize or cool down period, it will not light until they have completed. During a Refresh charge cycle, it will continue to stay lit.

Front Control Panel:

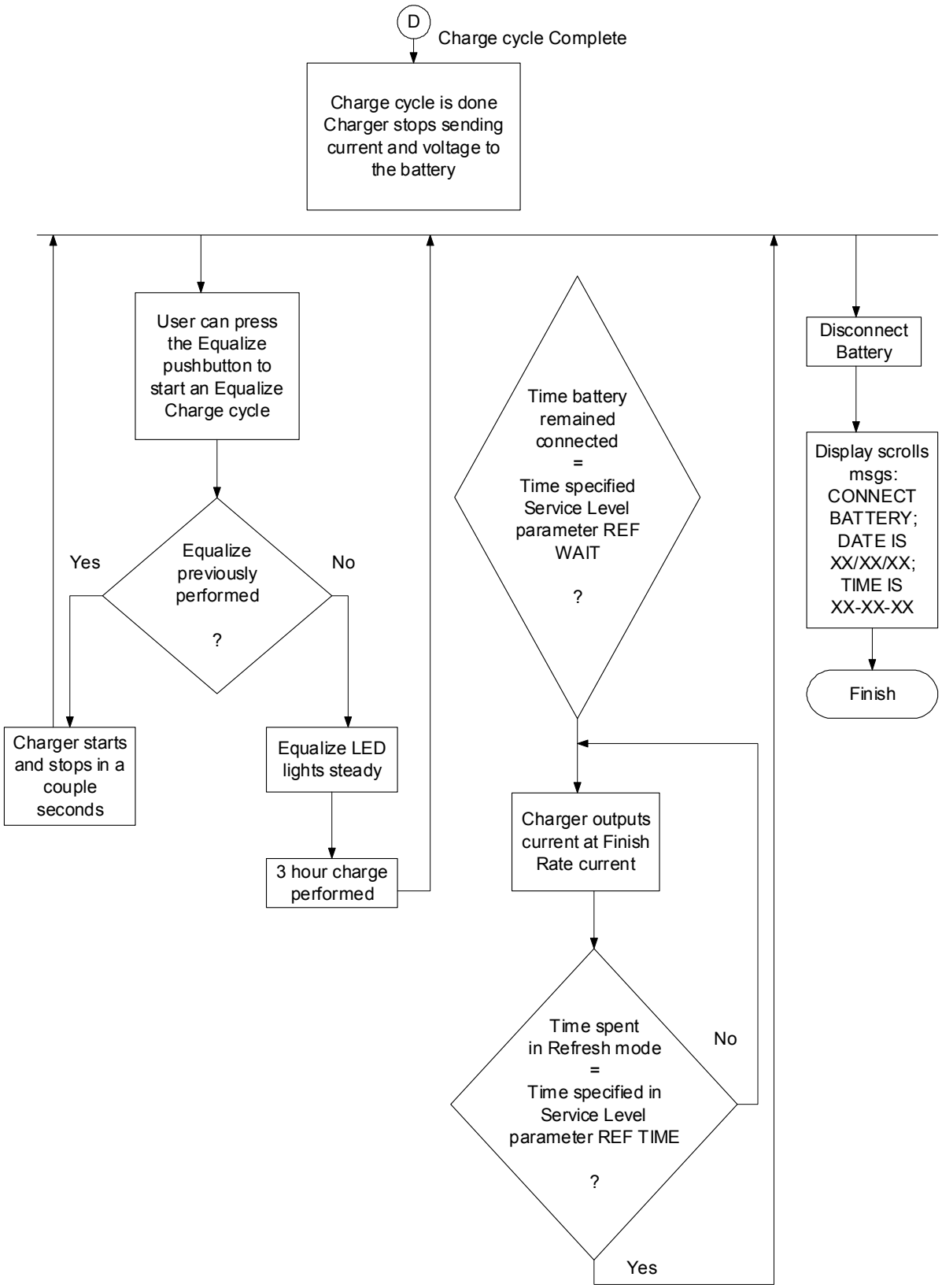


Charge Cycle in Automatic Mode




B
80% LED lights
Constant Voltage Mode
Charger begins sending constant voltage to the battery
User can: Press the Equal pushbutton to change charge cycle from Equalize to Daily (Equalize LED stops blinking)
or
User can: Press the Equalize pushbutton to change charge cycle from Daily to Equalize (Equalize LED starts blinking)
Charge current tapers down
Termination requirements satisfied ?
No
Yes
Finish LED lights
C
C
Finish Current mode
Charger begins sending constant current (Finish Rate current) to the battery
User can: Press the Equal pushbutton to change charge cycle from Equalize to Daily (Equalize LED stops blinking)
or
Press the Equalize pushbutton to change charge cycle from Daily to Equalize (Equalize LED starts blinking)
Finish Current mode complete ?
No
Yes
Is this an Equalize charge cycle ?
Yes
Equalize LED lights steady
Charging continues for 3 hours
No
D

Charge Cycle in Automatic Mode (con't)



RECHARGE CHARACTERISTICS

Please follow Recharge Characteristics, following, as you read through this description.
When a charge cycle begins, constant current is applied to the battery (Start-Current mode). This constant current, called Start-Rate current, is specified in Service-Level parameter START AMP.

When the Gassing-Voltage point (factory default is 80% charge voltage of 2.38 volts/cell) is reached, the charger stops applying constant current, and starts applying constant voltage (Constant-Voltage mode).

GASSING-VOLTAGE POINT NOT REACHED
If the Gassing-Voltage point is not reached during the time allotted (specified in Service-Level parameter MAX STIM, which is factory set for 7 hours), the Override timer will time out and shut down the charger. The charger's display will show a fault code that indicates a defective or mismatched battery.

GASSING-VOLTAGE POINT REACHED
When the Gassing-Voltage point is reached, the Override timer resets and timing begins again for Constant-Voltage mode.
During Constant-Voltage mode, the current tapers down to approximately 4.5 amps per 100 AH. At this point, the charger stops applying constant voltage and returns to applying constant current (Finish-Current mode). This constant current, called Finish-Rate current, is specified in Service-Level parameter FINISH AMP.

FINISH-CURRENT MODE NOT REACHED
If the Finish-Current mode is not reached during the time allotted (determined by the termination method, described in section Termination Method), the Override timer will time out and shut down the charger. The charger will display a fault code.

FINISH-CURRENT MODE REACHED
If the Finish-Current mode is reached, the charger will continue charging until termination time is reached.

EQUALIZE MODE
Equalize mode is basically the addition of 3 hours of charge.
If the charger is running, and equalize is selected, then an additional 3 hours of charge is added to the charge cycle's normal termination point.
If the charger's Complete LED turns on, and then Equalize is selected, the charger restarts and runs for 3 hours. It will start in Start rate and taper to Finish as needed by the battery.

REFRESH MODE
Refresh mode will be entered after the charge cycle has completed, if the battery is left connected to the charger for the period of time specified in Service-Level parameter REF WAIT (Refresh Wait Period, which is factory set for 12 hours).
During Refresh mode the charger applies constant current at the same rate as the current in Finish-Current mode. The time spent in Refresh mode is specified in Service-Level parameter REF TIME (Refresh Charging Time, which is factory set for 15 minutes).

CHECKING THE RECHARGE CHARACTERISTICS
You can monitor the battery voltage during Start-Current mode on a discharged battery. The battery voltage should gradually increase to 2.38 volts/cell (v/c) with the charging current at 16% of the battery and/or charger nameplate rating. Example: If you are using a 550 AH charger, the charging current during Start-Current mode will be 16% of 550 which is 88 amperes.

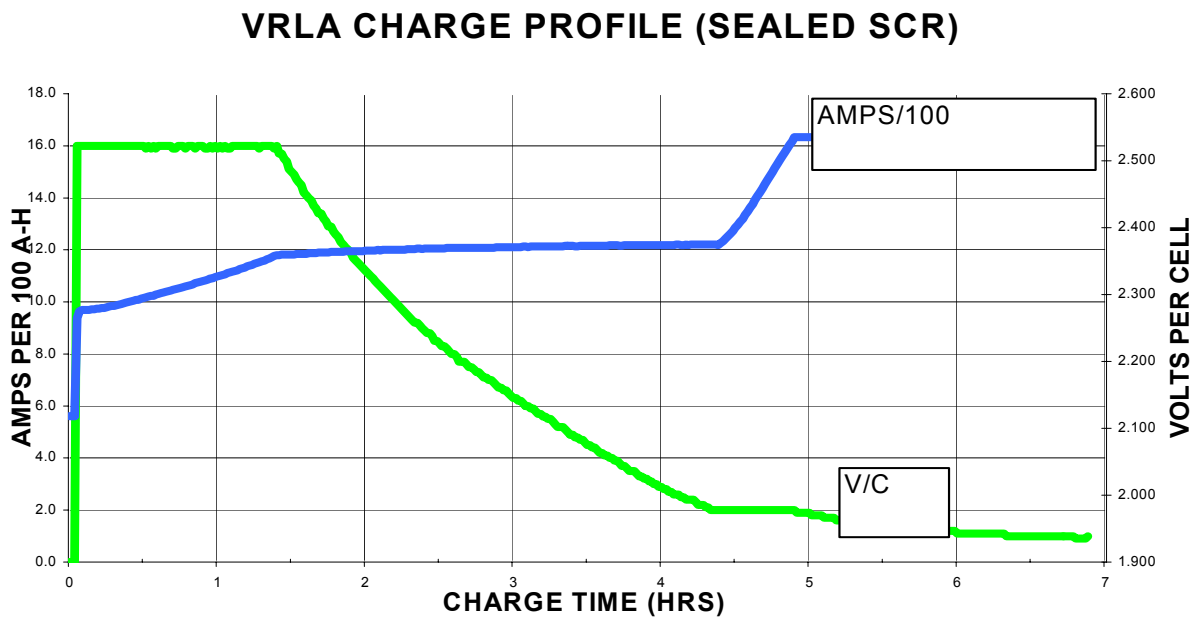
You can monitor the output voltage terminals during Constant-Voltage mode. The battery voltage should be steady at 2.38 v/c $\pm$ 1%, and the charge current should gradually decrease.
You can monitor the battery voltage during Finish-Current mode. The battery voltage should measure at least 2.38 v/c at a constant current of 4.5% of the charger's nameplate rating.

SEALED CELL CHARGERS

NOTE: In chargers specially configured to charge sealed cell batteries (model number prefix "S"), the following parameters have been set up:

Start Rate	16.0 Amps / 100 A-H
Finish Rate	2 Amps / 100 A-H
Gassing Point	2.37 Volts / Cell
Charge Time Limit	15 Hours
Termination Method	Time-Voltage

Recharge Characteristics, Sealed Cell



CHARGE-CYCLE TERMINATION METHODS

There are 5 types of termination methods:

Proportional,
Time Voltage (Program-Level parameter T-V TERM),
AH Return (Program-Level parameter AHRS TERM)
DV/DT (Program-Level parameter DVDT TERM), and
Finish Termination

DVDT TERM, T-V TERM, and AHRS TERM can be selected individually or in any combination. When a combination of termination methods have been selected, the first requirements satisfied will determine termination.

Proportional termination can only be selected by turning OFF all other methods of termination. It cannot be selected in combination with any of the others. Proportional termination should only be used when the battery is discharged more than 50% on a daily basis.

The model LT/LTC default setting is DV/DT and Time-Voltage Termination.

PROPORTIONAL

When the charger is set to Proportional termination, the charger remains in Start-Current mode (Service-Level parameter START AMP) until the Gassing-Voltage point (Service-Level parameter 80% V/CEL) is reached. Then control changes to Constant-Voltage mode, and maintains constant voltage until the output current matches the

current of Finish-Current mode (Service-Level parameter FINISH AMP). Control then reverts back to Constant-Current control.

The amount of time spent in Finish-Current mode is based on the time spent in Start-Current mode. The amount of time in Finish-Current mode is calculated by multiplying Service-Level parameter PROP FACTR by the time spent in Start-Current mode.

To select Proportional termination, set the other termination's methods OFF (Program-Level parameters DVDT TERM, T-V TERM, and AHRS TERM).

TIME VOLTAGE
Time-Voltage termination (Program-Level parameter T-V TERM) follows the same I-E-I path as described in Proportional, except that the amount of time left in the charge cycle after the Gassing-Voltage point is reached is specified in Program-Level parameter POST 80%.

AMPHOURS RETURNED
AH-Returned termination (Program-Level parameter AHRS TERM) follows the same I-E-I path as described in Proportional, except that a charge cycle ends when the accumulated AH returned during the charge cycle equals the value set in Program-Level parameter TERM AHS.

DV/DT
DV/DT termination (Program-Level parameter DVDT TERM) follows the same I-E-I path as described in Proportional, except that the charge cycle ends when the change in voltage is acceptable for a specified period of time (Program-Level parameter DV/DT SP)

FINISH TERMINATION
The charger can be set to terminate a charge normally (i.e., non fault) at the start of the Finish Phase.

MESSAGES

BATTERY NOT CONNECTED
When no battery is connected, and AC power is applied to the charger, one of the following set of messages will display (in rotation) on the front panel:

If Program-Level parameter VVR FUNC is off:
CONNECT BATTERY
DATE IS 00/00/00 (month/date/year)
CONNECT BATTERY
TIME IS 00-00-00 (hours-minutes-seconds)

If Program-Level parameter VVR FUNC is on, and
User-Level parameter VVR OPTION is off:
NORMAL CHARGE
DATE IS 00/00/00 (month/date/year)
CONNECT BATTERY
TIME IS 00-00-00 (hours-minutes-seconds)

If Program-Level parameter VVR FUNC is on, and
User-Level parameter VVR OPTION is on:
VVR CHARGE
DATE IS 00/00/00 (month/date/year)
SET FOR 00 CELLS
TIME IS 00-00-00 (hours-minutes-seconds)

BATTERY CONNECTED
When a battery is first connected to a powered-up charger, the display will show this message: STARTING CHARGER

Then, in 60 seconds (if in Automatic mode), the charger will start outputting Start-Rate current, and the messages in the following table will begin to display.

These values are displayed in rotation for the amount of time specified in Program-Level parameter CHG HLD. Other messages are added to this scrolling display as needed (such as "CHG 80 % REACHED"). All messages that can be seen in this scrolling display are listed in the following table.

Push the Up- and Down-Arrow push-buttons to display the information described in the following table. This information can be viewed whether or not the charger is in a charge cycle.

Charge-Time Messages

Messages that are always displayed during a charger cycle	
Message	Description
CURRENT = 000.0	Charger current in amps
VOLT / CELL = 0.000	Volts per Cell
AH RET'D = 0000	Amp-hours returned to the battery
CHG TIME = 00-00	Time spent in the charge cycle (hours-minutes)
Messages that are added when an event occurs	
Message	Description
CHG 80% REACHED	Begins to display when the Gassing-Voltage point has been reached.
EQUALIZE CYCLE	Begins to display when the 3 hour equalize period starts.
BATT COOL DOWN	Displays after CHARGE COMPLETE during a Daily charge cycle.
REFRESH CYCLE	Begins to display when a Refresh charge cycle starts.
CHARGE COMPLETE	Displays when a charge has successfully completed.
CHARGE STOPPED	Displays when the Stop push-button is pressed while a charge is in progress.

Additional Information

BATT VOLTS = 000.00	Displays the battery voltage.
BATT CELLS = 00	Displays the cell size of the battery.
AH RATING =0000	Displays the charger's AH setting.
TIME IS 00-00-00	Displays the Real-Time clock.

NOTE: A 40 cell charger will generally start up and indicate 36 cells. After a few minutes of running on a discharged battery, the charger will correct itself to 40 cells.

FAULT MESSAGES

The charger's control circuitry constantly monitors for several fault conditions. If a fault should occur, the charge in progress is interrupted, a fault message displays on the front control panel, and the fault message is entered into the Log-Data file.

Fault Messages

Message	Description
AC POWER FAULT	Displays, during a charge cycle, when the AC line voltage falls below 10% of the nominal line voltage. **Possible Causes:** Check the complete contactor coil string and associated wiring (LTC with line contactor only) AC brownout AC failure AC phase loss Bad AC fuse
CHECK AC FUSES	Displays, when not in a charge cycle, if the AC line voltage falls below 10% of the nominal line voltage. **Possible Causes:** AC failure AC phase loss Bad AC fuse
CURRENT TOO HIGH	Displays when high DC output current is detected. High Current is defined to be current that is 30% above Start-Rate current during the beginning of a charge cycle, or 30% above Finish-Rate current at the end of a charge cycle. **Possible Causes:** Battery problem
CURRENT TOO LOW	Displays when low current is detected. Low current is defined to be current that is 20% below Start-Rate current during the beginning of a charge cycle, or 20% below Finish-Rate current at the end of a charge cycle. **Possible Causes:** Loose connection in output string (shunt, cable lug, etc.) Battery inter-cell problem.
DC FUSE/CBL OPEN	Displays if current falls below the minimum setting. **Possible Causes:** The DC cable unplugged during charge DC fuse opened open or defective Loose connection in output string (shunt, cable lugs, etc.) Battery problem
HIGH APHR RET'D	Displays when more than 220% of the amp hours have been delivered to the battery. **Possible Causes:** Battery does not match AH range on charger's nameplate Charger's AH rating programmed wrong SCR failure during last use

Message	Description
HIGH BATT VOLTS	Displays, after a battery is connected, if the battery with a cell size larger than specified on the charger's nameplate is connected to the charger. Displays, during a charge cycle, when reaches 3 v/c of the battery cell size the charger has selected at that given time. **Possible Causes:** Wrong cell size applied to charger Old sulfated battery
MAX CHG TIM OVER	Failed to complete the charge cycle within the time specified in Service-Level parameter MAX CTIM. **Possible Causes:** Battery AH rating may be larger than charger AH rating Battery temperature may be too high Bad cells in the battery
NO BATT VOLTS	No battery voltage when expected **Possible Causes:** Loose V-DC control wires
START TIME EXCED	Displays when the charger remains in Start Rate longer than permitted. **Possible Causes:** Battery's AH rating may be larger than the charger's AH rating. Battery temperature may be too high Cell failure Failed to reach the Gassing-Voltage point within 7 hours (factory default setting) of the start of charge.
CHECK SET UP	Displays, when a battery is connected, if the battery is greater than 3 v/c. **Possible Causes:** Parameters programmed incorrectly for this battery Bad connection at pins 1 and 2 of the ID board.

Determine the cause of the fault and correct it before resetting the Fault-Condition monitor and trying to charge the battery again. The Fault code is cleared by pressing the Select push-button, by disconnecting and re-connecting the battery, or by using the CLEAR FAULTS select function (if that function is enabled).

Log-Data File

The Log-Data file contains a history of significant charger activity. All entries begin with the date and time the event happened. The entries include information such as faults, charger parameter changes, when a charge cycle began, etc.

There are also periodic entries (every 15 minutes) in the Log-Data file when a battery is connected to the charger. These periodic entries include: date and time of the entry, voltage, amperage, etc.

The Log-Data file can be viewed from the display on the charger's front control panel through User-Level parameter LOG DATA or it can be electronically sent to a printer or to a computer through a non-isolated RS-232 serial communication link on the PC board. Use Service-Level parameter PRNT LINE to specify how many lines of the Log-Data file you want printed.

When using the terminal or printer, be sure to set the Service-Level parameters BAUD RATE, COMM FUNC, and PRINT FUNC.

You can configure your charger to automatically output data over the RS-232 port, at regular intervals, the status of the charger and the charge cycle with Service-Level parameter PRINTIME.

SAMPLE OF LOG DATA FILE

07/28/94 09:19:43 PASSKEY INSERTED
V=038.8 A=000.6 AH=0564 CT=18:08 BC=18 CAH=0850 CC=0002
CHARGER REVISION=3LH-V1.1 PASSKEY=65021 Led PATTERN=000

07/28/94 09:19:43 AC POWER ON
V=038.8 A=000.6 AH=0564 CT=18:08 BC=18 CAH-0850 CC-0002
CHARGER REVISION=3LH-V1.1 PASSKEY=65021 LED PATTERN=000

07/28/94 09/19:42 PERIODIC LOG ENTRY
V=038.8 A=000.6 AH=0564 CT=18.08 BC=18 CAH=0850 CC-0002
CHARGER REVISION=3LH-V1.1 PASSKEY=65021 LED PATTERN=000

07/28/94 09:06:45 PERIODIC LOG ENTRY
V=038.9 A=000.6 AH=0564 CT=18:08 BC-18 CAH=0850 CC=0002
CHARGER REVISION=3LH-V1.1 PASSKEY=00000 LED PATTERN=000

07/28/94 08:56:31 FAULT -MAX CHG TIME OVER
V=039.6 A=038.1 AH=0564 CT-18:08 BC=18 CAH=850 CC-0002
CHARGER REVISION=3LH-V1.1 PASSKEY=00000 LED PATTERN=000

07/28/94 08:56:20 STARTING CHARGE
V=038.8 A=000.8 AH=0564 CT=18:08 BC=18 CAH=0850 CC-0002
CHARGER REVISION=3LH-V1.1 PASSKEY=00000 LED PATTERN=000

PROGRAMMABLE PARAMETERS

For security purposes, there are 3 levels of programmable parameters:
- User level,
- Service level
- Program level.

These levels are described below.

USER LEVEL

The User level is used to do such things as: clear faults, set the Real-Time clock, enable delay start, set equalize day or equalize count, and view the Log-Data file.

No hardware key or password is required to access this level.

Enter the User level by pressing the Select push-button. Use the Up- and Down-Arrow push-buttons to scroll through the variables you can modify. To exit the User level, press the Equal push-button.

The following table describes the variables you can change at the User level, and the following sections describe how to change each variable. A parameter will only be accessible at the User level if permission was granted at the Service or Program level.
NOTE: The User level cannot be entered during a charge cycle.

User-Level Functions

Display Contains	Variable(s)	Description
Block Out Time	BO START BO END	Sets up Block Out periods when charger will not start charging a battery.

Display Contains	Variable(s)	Description
AMP HOUR RATING	Charger AH	Set to the charger's nameplate rating, or to the AH rating of the battery being charged. This parameter is the same as Service Level parameter CHGR AHRS. Changing this parameter automatically causes adjustments to be made to Service Level parameters START AMP and FINISH AMP. This parameter is only accessible if Service Level parameter CHARG FUNC is set to ON. The range is 0 to nameplate rating. The factory setting is the AH nameplate rating.
CHGR CELL SIZE	Charger Cell Size	Set to the charger's nameplate cell rating. This is the number of cells in a battery that your charger is designed to be able to charge. This parameter is only accessible if Service Level parameter CCELL FUNC is set to ON. **NOTE:** If this parameter is set to any other number than 6,9,12,15,18,24,36 or 40, the charger will not perform automatic sizing of the battery, and it will not automatically start a charge cycle. The range is 0 to (nameplate rating +1). The factory setting is the cell size nameplate rating.
CLEAR FAULTS or FAULTS ARE CLEAR	Clears fault messages	This parameter is only accessible if Service Level parameter CLEAR FUNC is set to ON.
LOG DATA PRINT	Allows you to view or print the Log-Data file	This parameter is only accessible if Service Level parameters LOG FUNC and FUNC are set to ON.
SET CLOCK		Real Time clock contains the current date (month, day of week, day of month, year) and the current time (hour, minute). **NOTE:** The real time clock must be set for the charger to automatically perform equalize and delay functions. This parameter is only accessible if Service Level parameter CLOCK FUNC is set to ON.
SET DELAY	Delay Start Time/ Wait Until Time	Functional when the charger is set to Automatic mode (Service Level parameter manual OP). Determines how long the charger will wait before beginning the charge cycle after the control circuitry determines that a battery is connected. See section Setting the Delay for more information. This parameter is only accessible if Service Level parameter DELAY FUNC is set to ON. **NOTE:** Wait Until Time specifies the exact time a charger will start (if a battery is connected). If a battery is connected after the time specified in Wait Until Time, then the charge will not start. The range is 00:00 to 23:59 for Wait Until Time (00: to 13:12 for Delay Start Time) The factory setting is 00:00.
SET EQUALIZE	Equalize Day/Equalize Counter	Functional when the charger is set to Automatic mode (Service Level parameter MANUAL OP). Determines when an Equalize charger cycle will automatically occur. Equalize Day sets the day of the week that the automatic Equalize charge cycle will be done. Equalize counter determines how often an Equalize charge cycle will occur. When the Cycle counter (Service Level parameter CHG CYCLE) = Equalize counter, an Equalize charge cycle occurs, and the Cycle counter is reset to 1. Only Equalize day or Equalize counter will be active, not both. The last one you modified, is the one that is active. This parameter is only accessible if Service Level parameter EQUAL FUNC is set to ON. The factory setting is Equalize Counter = 5.

Display Contains	Variable(s)	Description
VVR OPTION		Enables or disables a VVR (variable voltage rectifier) charge. A VVR charge is a constant-current charge for a specified period of time. When the VVR option is ON, you can change the 4 VVR parameters: VVR CELLS, VVR AMPS, VVR CHARGE TIME, and VVR PRINT TIME. See section Setting the VVR Parameters for more information. **WARNING:** Contact Technical Support and your battery manufacturer before performing a VVR charge. This parameter is only accessible if Program Level parameter VVR FUNC is set to ON. The range is ON or OFF. The factory setting is OFF.

Charger Cell Size Vs Range of Battery Cell Sizes

Charger's Nameplate Rating	Battery Cell Range
40 cells	40, 36, 24, 18
24 cells	24, 18, 12, 6
18 cells	18, 12, 6
12 cells	12, 6

Setting the Date and the Real-Time Clock Parameter

To change the date or time of the Real-Time clock, please follow these steps.

1. Press the Select push-button to enter the User level.
2. Use the Up- and Down-Arrow push-buttons to scroll through the variables until "SET CLOCK" displays.
3. Press the Select push-button if you want to change the date or time. (Press the Equal push-button to return to Display mode.) After the Select push-button is pressed, "YEAR" will display.
   a. Use the Up- and Down-Arrow push-buttons to scroll through the following Real-Time clock parameters:
      Year - Month - Date (day of the month) - Day (day of the week) - Hour - Minute.
   b. When the parameter you want to change is displayed, press the Select push-button. The value of the parameter is now displayed.
   c. Use the Up- and Down-Arrow keys to change the value in the display.
   d. Press the Select push-button to save the new value you just entered, or press the Equal push-button to keep the old value.
   e. To change another parameter of the Real-Time clock, repeat Steps 3a through 3d.
4. Once you have completed changing the Real-Time clock, press the Equal push-button. "SET CLOCK" should now be back in the display.
5. Press the Equal push-button once again to exit the User level.

Setting the Delay

SET DELAY has 2 parameters: WAIT and UNTIL. WAIT specifies the amount of time the charger will wait before beginning a charge cycle. UNTIL specifies the exact time of day that the charge cycle will begin. Also, SET DELAY can be turned ON and OFF.

To turn SET DELAY on or off, or to change WAIT or UNTIL, please follow these steps.

1. Press the Select push-button to enter the User level.
2. Use the Up- and Down-Arrow push-buttons to scroll through the variables until "SET DELAY" displays.
3. Press the Select push-button if you want to turn SET DELAY on or off, or to change WAIT or UNTIL. (Press the Equal push-button to return to Display mode.) After the Select push-button is pressed, "DELAY OFF" or "DELAY ON" will be displayed.
4. Use the Up- and Down-Arrow push-buttons to scroll through these options:
   Delay On - Delay Off
5. To turn off Automatic delay, put "DELAY OFF" in the display, and press the Select push-button. "DELAY IS OFF" will display until you release the push-button, then "DELAY OFF" will return to the display. This resets the delay settings to their default values. Press the Equal push-button twice to return to Display mode.
6. To turn on Automatic delay or to change WAIT or UNTIL, put "DELAY ON" in the display, and press the Select push-button. "DELAY IS ON" will display until you release the push-button. "UNTIL" will display when you release the push-button. Use the Up- and Down-Arrow push-buttons to scroll through the Delay parameters:
   Until - Wait

a. When the parameter you want to select or program is displayed, press the Select push-button. The value (default or last value entered) of the parameter is now displayed.
b. Use the Up- and Down-Arrow keys to change the value in the display.
c. Press the Select push-button to save the new value you just entered, or press the Equal push-button to keep the old value.

7. Press the Equal push-button 3 times to exit the User level.

Setting the Equalize Parameter

There are 2 Equalize parameters: Equalize day and Equalize counter. If Equalize day is set, an Equalize charge cycle will begin when a charge cycle starts on the day specified in Equalize day. If a Daily Charge has completed on a day other than the Equalize Day and the battery remains connected to the charger, an Equalize Charge will be applied to the battery when the Equalize Day occurs. If Equalize counter is set, an Equalize charge cycle will begin when the Cycle counter equals the Equalize counter. After an Equalize charge cycle, the Cycle counter will be reset to 1, and the Equalize parameter will remain the same.

To change an Equalize parameter, please follow these steps.

1. Press the Select push-button to enter the User level.
2. Use the Up- and Down-Arrow push-buttons to scroll through the variables until "SET EQUALIZE" displays.
3. Press the Select push-button if you want to change an Equalize parameter. (Press the Equal button to return to Display mode.) After the Select push-button is pressed, "DAY" will be displayed.
   a. Use the Up- and Down-Arrow push-buttons to scroll through the following Equalize parameters:
   Day - Count
   b. When the parameter you want to change is displayed, press the Select push-button. The value of the parameter is now displayed.
   c. Use the Up- and Down-Arrow keys to change the value in the display.
   d. Press the Select push-button to save the new value you just entered, or press the Equal push-button to keep the old value.

NOTE: If you set both the Equalize day and the Equalize counter parameters, only the last one set will be active.

4. Once you have completed changing the Equalize parameters, press the Equal push-button.
5. Press the Equal push-button once again to return to exit the User level.

Setting the Clear Fault/Faults Are Clear Parameter

To clear a fault or to verify if the fault monitor contains a fault code, please follow these steps.

1. Press the Select push-button to enter the User level.
2. Use the Up- and Down-Arrow push-buttons to scroll through the variables until "CLEAR FAULTS" or "FAULTS ARE CLEAR" is displayed.
   a. If "FAULTS ARE CLEAR" is displayed, then there are no faults in the fault monitor.
   b. If "CLEAR FAULTS" displays, press the Select push-button to clear the faults.

Pressing the Equal push-button will exit you from the User level, but will NOT clear the faults.

Viewing the Log-Data File

To look at the Log-Data file on the display or to send it to a printer, please follow these steps.

NOTE: Verify that the baud rate (Service-Level parameter) is set properly for your printer.

1. Press the Select push-button to enter the User level.
2. Use the Up- and Down-Arrow push-buttons to scroll through the variables until “LOG DATA” displays.
3. Press the Select push-button if you want to view the Log-Data file on the display screen or send it to a serial printer. (Press the Equal push-button to return to Display mode.) After the Select push-button is pressed, “VIEW LOG” will display.
4. Use the Up- and Down-Arrow push-buttons to scroll through the following Log-Data file parameters:
   View Log - Print Log
5. To send the Log-Data file to a printer, put “PRINT LOG” in the display, and press the Select push-button. “LOG PRINT DONE” will display when the file has been sent to the printer. The number of lines of data that will print is determined by Service-Level parameter PRNT LINE.
   Press the Equal push-button to stop a printout. “LOG PRINT ABORTD” will display.
   If the display contains “LOG PRINT ABORTD” or “LOG PRINT DONE”, press the Select push-button to reprint the Log-Data file.
   Press the Equal push-button twice more to return to Display mode.

6. To view the Log-Data file on the display screen, put “VIEW LOG” in the display, and press the Select push-button.

The display will begin to automatically scroll through the data saved during the last event.

To view the data, use the Up- and Down-Arrow push-buttons to access different lines (entries) of data in the Log-Data file. Each line number contains the data about a different event.

NOTE: Pressing the Up-Arrow push-button while the most recent entry is displayed will cause the oldest entry in the log to display. The Log-Data file can store up to 1000 entries.

When the Log-Data file becomes full, the new entries will overwrite the oldest entries.

Once you are done viewing the Log-Data file, press the Equal push-button.

Press the Equal push-button 2 more times to exit from the User level.

Setting the VVR Parameters

To set the VVR parameters, please follow these steps.

1. Press the Select push-button to enter the User level.
2. Use the Up- and Down-Arrow push-buttons to scroll through the variables until “VVR OPTION” displays.
3. Press the Select push-button if you want to toggle the “VVR OPTION” off or on. (Press the Equal push-button to return to Display mode.) After the Select push-button is pressed, “VVR ON” or “VVR OFF” will display.
   a. Use the Up- and Down-Arrow push-buttons to scroll through the following options:
      i. “VVR ON”
      ii. “VVR OFF”
   b. When the option you want is displayed, press the Select push-button.
4. If you selected “VVR OFF” press the Equal push-button twice to return to Display mode.
5. To make changes to the VVR parameters (VVR CELLS, VVR AMPS, VVR CHARGE TIME, VVR PRINT TIME), please follow these steps.
   a. Press the Select push-button when “VVR ON” is in the display.
   b. Use the Up- and Down-Arrow push-buttons to scroll through the VVR parameters:
      i. VVR CELLS,
      ii. VVR PRINT TIME (00-00 to 32-00) (hours-minutes),
      iii. VVR CHARGE TIME (00-00 to 32-00) (hours-minutes),and
      iv. VVR AMPS (000.1 to 136.0).
   c. When the parameter you want to change is displayed, press the Select push-button. The value of the parameter is now displayed.
   d. Use the Up- and Down-Arrow keys to change the value in the display.
   e. Press the Select push-button to save the new value you just entered, or press the Equal push-button to keep the old value.
   f. To change another VVR parameter, repeat steps b through e.
   g. Once you have completed changing the VVR parameters, press the Equal push-button.
   h. Press the Equal push-button 2 more times to return to the User level.

SERVICE LEVEL/PROGRAM PARAMETERS

Verify that the control board's part number for (S)LT2, (S)LTC2 is X1060-60LT-1

NOTE: Refer to the Field Enhancement / Upgrade decal, located on the inside part of the door, to see if the charger has any custom settings.

This level allows you to change basic charge parameters such as Start-Rate current, Gassing-voltage point, Refresh times, etc. A special hardware key is required to gain access to this level.

Enter the Service level by inserting the hardware key onto the PC board's connector J10. When the hardware key is in place, the display will contain "PASS-KEY=xxxxx." You now have access to the Service level functions. You will remain in the Service level whether you remove the hardware key or not.

Use the Up- and Down-Arrow push-button to scroll through the parameters. Press the Select push-button when the variable to be changed is displayed. Pushing the Select push-button causes the present value of the variable to be shown in the display. Use the Up- and Down-Arrow push-buttons to change the value in the display. Press Select to save the new value, or press Equal to keep the old value and exit Variable mode.

When Equalize is pressed again, the charger displays "REMOVE PASSKEY" if the hardware key was not yet removed.

Service-Level Parameters

Function Name	Description
1. CHGR AHRS	Set to the charger's nameplate rating, or to the AH rating of the battery being charged. This parameter is the same as User-Level parameter AMP HOUR RATING. Changing this parameter automatically causes adjustments to be made to Service-Level parameters START AMP and FINISH AMP. The range is 0 to nameplate rating. The factory setting is the AH nameplate rating.
2. CHGR CELLS	Set to the charger's nameplate cell rating. This is the number of cells in a battery that your charger is designed to be able to charge. This parameter is the same as User-Level parameter CHGR CELL SIZE. **Note:** If this parameter is set to any other number than 6,9,12,15,18,24,36 or 40, the charger will **not** perform automatic sizing of the battery. The range is 0 to (nameplate rating + 1). The range is Finish-Rate current to Start-Rate current.
3. START AMP	Start-Rate current in amps. found by multiplying the battery AH by 16%. START AMP will automatically be changed when Service-Level parameter CHGR AHRS or User-Level parameter AMP HOUR RATING is changed. **WARNING The charger may not be able to reach a Gassing-Voltage point above 2.45 v/c at Start-Rate current when low-line conditions exist.** The factory setting is the nameplate rating.
4. 80% V/CEL	The gassing-voltage point. In the charge cycle, this pint indicates the end of start current mode and the beginning of constant voltage mode. The range is 0.100 to 3.150. The factory setting is 2.380.
5. FINISH AMP	Found by multiplying battery AH by 4.5%. In the charge cycle, this is the current rate during Finish-Current mode. FINISH AMP will automatically be changed when Service-Level parameter CHGR AHRS or User-Level parameter AMP HOUR RATING is changed. If this parameter is set to a value lower than Service-Level parameter MIN AMPS, then MIN AMPS will automatically be reset to FINISH AMP minus 1. The range is 003.0 to Start-Rate current (Service-Level parameter START AMP).
6. MIN AMPS	The minimum output current, in amps, that may occur in a charge cycle. If the current drops below this level, the cycle will terminate, because the charger assumes the DC cord is unplugged or the DC fuse is opened. If FINISH AMP (Service-Level parameter) is set below this parameter, then MIN AMPS will automatically be adjusted to FINISH AMP minus 1. The range is 001.0 to FINISH AMP minus 1. The factory setting is 002.0.
7. MAX STIM	Maximum time in Start-Current mode. If a battery does not reach the Gassing-Voltage point within the time specified by this timer, the charge cycle will be terminated. **Note:** MAX STIM = Maximum time in Start-Current mode. **Note:** A different function, MAX CTIM, specifies the time limit on the total charge cycle. The range is 00-00 to 18-12. The factory setting is 07-00.

Function Name	Description
8. MAX CTIM	Charge-cycle time limit (hours-minutes). The range is 00-00 to 32-00. The factory setting is 12-00.
9. COOLTIME	Cool down time after the charge cycle has completed (output current has stopped), but before the battery is ready to use. The Complete LED will light after the cool down time has finished. The range is 00-00 to 18-12. The factory setting is 00-00.
10. REFS FUNC	Enables the charger to automatically perform Refresh charge cycles. The range is OFF or ON. The factory setting is ON.
11. REF WAIT	Time between the end of a charge cycle and the beginning of a refresh cycle, provided that the battery is left connected to the charger. The range is 01-00 to 18-12. The factory setting is 12-00.
12. REF TIME	Time spent doing a Refresh charge. The range is 00-00 to 02-30. The factory setting is 00-15.
13. MANUAL OP	Specifies whether the charger will run in Manual or Automatic mode. ON = Manual mode. OFF = Automatic mode. The range is ON or OFF. The factory setting is OFF.
14. T-V TERM	Enables Time-Voltage charge-cycle termination. This termination method determines the amount of time, after the Gassing-Voltage point is reached, that a charge cycle will take. Program-Level parameter POST 80% specifies when the charge cycle will terminate. The range is OFF or ON. The factory setting is ON.
15. POST 80%	For Time-Voltage termination, specifies the amount of time remaining in a charge cycle after the Gassing-Voltage (80%) point is reached. To turn on Time-Voltage termination, set Program-Level parameter T-V TERM to ON. The range is 00-00 to 18-12. The factory setting is 05-00 (5 hours).
16. DVDT TERM	Enables DV/DT charge-cycle termination. This termination method is based on the battery voltage desired. Program-Level parameter DV/DT SP is used to determine when the charge cycle will terminate. The range is OFF or ON. The factory setting is ON.
17. DV/DT SP	**Note:** Consult Technical Support before changing this parameter. To turn on DV/DT termination, set Program-Level parameter DVDT TERM to ON. The range is 00-01 to 02-00. The factory setting is 00-15.
18. AHRS TERM	Enables Amphours-Returned termination. This termination method is based on the number of AH returned to the battery. Program-Level parameter TERM AHS specifies when the charge cycle will terminate. The range is OFF or ON. The factory setting is OFF.
19. TERM AHS	For AH termination, specifies the number of AH put back in a battery. When the battery reaches this level, the charge cycle is complete. To turn on AH termination, set Program-Level parameter AHRS TERM to ON. The range is 0000 to 220% of nameplate. The factory setting is 1250.

Function Name	Description
20. PROP FACTR	When Proportional termination is selected, PROP FACTR determines when a charge-cycle will terminate. This parameter is a percentage. The charger uses it to calculate the amount of time that will be spent in Finish-Current mode. Time in Finish-Current mode = PROP FACTR times the amount of time spent in Start-Current mode. **Note:** To select Proportional termination, set the following Program-Level parameters to OFF: DVDT TERM; T-V TERM; AHRS TERM. The range is 000 to 100. The factory setting is 040.
21. PAUSTIME	Specifies how long a charge cycle will pause before automatically restarting. A pause is caused by pressing the Start/Stop push-button while a charge is in progress, and leaving the battery connected to the charger. **Note:** Service-Level parameter MANUAL OP must be set to OFF for PAUSTIME to work. The range is 00-00 to 04-00. The factory setting is 01-00 (1 hour).
22. CHG CYCLE	Increments each time a charge cycle successfully completes. If less than 1 hour was spent in Start-Current mode, then CHG CYCLE will not be incremented. If the charger is set for Automatic Equalize (Service-Level parameter MANUAL OP), the charger will automatically perform an Equalize charge cycle when CHG CYCLE equals the Equalize counter (User-Level parameter). After an Equalize charge cycle is performed, CHG CYCLE resets to 1. The Equalize counter remains the same. The range is 01 to 99. The factory setting is 01.
23. RUNS	Counts the number of charge cycles started. It does NOT count restarts. This parameter is resettable. The range is 00000 to 32767. The factory setting is 00000.
24. CABLE	DC cable length, in inches, used to determine the voltage at the battery. The charger calculates the voltage drop across the cable and compensates for it. The calculation is based on the CABLE parameter and the assumption that the cable size is the same as the original cable supplied by the factory. The range is 0 to 3816. The factory setting is 156. **Note:** The factory setting of 156 includes 8 feet (96”) of charger cable and 5 feet (60”) of cabling on the battery. If the charger or battery cables are different, the cable parameter should be changed.
25. CHG HLD	The display period of each variable during a charge cycle (minutes-seconds). The range is 00-01 to 05-00. the factory setting is 00-02.
26. SEL HLD	Display period when the Up- or Down-Arrow push-button is pressed (minutes-seconds). The range is 00-01 to 05-00. The factory setting is 00-04
27. OVERD FUNC	Allows a user to override a delayed start (User-Level parameter SET DELAY) by pressing the Start push-button. The range is ON or OFF. The factory setting is OFF.
28. RND DEL FUNC	When ON, causes a random amount of time to be added to the delay time (User-Level parameter SET DELAY) if power was lost when a battery was connected. This is useful when you want your chargers to stagger their charge cycles. The range is OFF or ON. The factory setting is OFF.

Function Name	Description
29. EQUAL FUNC	When ON, SET EQUALIZE is accessible at the User-Level. The range is ON or OFF. The factory setting is ON.
30. DELAY FUNC	When ON, SET DELAY is accessible at the User-Level. The range is ON or OFF. The factory setting is ON.
31. BLOCK OUT FUNC	When ON, BLOCK OUT TIME is accessible at the User-Level The range is ON or OFF The factory setting is OFF
32. BLOCK OUT ENABLE	Enables the BLOCK OUT TIME. When ON this enables the BLOCK OUT START and BLOCK OUT END timers. The range is ON or OFF The factory setting is OFF
33. BLOCK OUT START	Selects the time when the BLOCK OUT TIME starts. The range is 00-00 to 23-59 The factory setting is 00-00
34. BLOCK OUT END	Selects the time when the BLOCK OUT TIME ends. The range is 00-00 to 23-59 The factory setting is 00-00
35. LOG FUNC	When ON, LOG DATA is accessible at the User-Level. The range is ON or OFF. The factory setting is ON.
36. PERIOD LOG FUNC	When ON it enables periodic entries every 15 minutes into the Log-Data File. The Log-Data File can be viewed from the charger display, computer monitor, or printer. The range is ON or OFF The factory setting is OFF.
37. CHRG GELL	Set to ON to charge gel-cell batteries. The following lists the parameters that automatically change when this function is enabled. NOTE: VRLA TERM must also be set to ON FINISH AMP = 2 A./100AH 80% V/CEL = 2.37 POST 80% = 06-00 DVDT TERM = OFF The range is OFF or ON. The factory setting is OFF.
38. VVR FUNC	When ON, VVR OPTION is accessible at the User-Level. The range is OFF or ON. The factory setting is OFF.
39. CAHRS FUNC	When ON, AMP HOUR RATING is accessible at the User-Level. The range is ON or OFF. The factory setting is OFF.
40. CCELL FUNC	When ON, CHGR CELL SIZE is accessible at the User-Level. The range is ON or OFF. The factory setting is OFF.
41. CLEAR FUNC	When ON, CLEAR FAULT is accessible at the User-Level. The range is ON or OFF. The factory setting is ON.
42. CLOCK FUNC	When ON, SET CLOCK is accessible at the User-Level. The range is ON or OFF. The factory setting is ON.

Function Name	Description	
43. EDIT FUNC	Forces the default factory settings to be entered into all parameters. To force default data into all the parameters, set this function ON, remove the hardware passkey, and turn the AC power off then on. Default data will have been entered in all the parameters, and this function will have been set to OFF. Note: Another way to force default data throughout the system is to turn AC power off, press and hold down the SELECT and EQUAL push-buttons, turn AC power back on, and then releasing the push-buttons. The range is ON or OFF. The factory setting is OFF.	
44. BAUD RATE	This sets the baud rate for the optional communications board (value multiplied by 100). The range is 003 to 192. The factory setting is 096.	
45. PRINT FUNC	Enables the serial printer. The range is ON or OFF. The factory setting is OFF.	
46. PRINTIME	How often the optional printer will print monitoring data. Note: Service-Level PRINT FUNC must be set to ON for this function to operate. The range is 00-01 to 18-12. The factory setting is 00-15 (15 minutes).	
47. PRNT LINE	Number of lines of the Log-Data file to be printed when PRINT LOG of User-Level parameter LOG DATA is selected. The range is 0001 to 1000. The factory setting is 1000.	
48. COMM FUNC	Set to ON when a communications board is installed in the charger. Note: This function is not yet implemented. The range is ON or OFF. The factory setting is OFF.	
	a. CHRG NETWK	Enables the Charge network (requires optional communications board and Service-Level parameter COMM FUNC=ON). Note: This function is currently not implemented. The range is ON or OFF. The factory setting is OFF.
	b. BAT ID FNC	When ON, BATT is accessible at the User-Level. The range is ON or OFF. The factory setting is OFF.
	c. CHG ID FNC	When ON, CHGR ID is accessible at the User-Level. The range is ON or OFF. The factory setting is OFF.
	d. TRCK ID FNC	When ON, TRUCK ID is accessible at the User-Level. The range is ON or OFF. The factory setting is OFF.
49. VRLA TERM	Enables VRLA/Sealed Cell termination. For Value - Regulated Lead Acid or Sealed Cell battery charging. NOTE: CHRG GELL parameter must also be set to ON. The range is ON or OFF. The factory setting is OFF.	
50. FINISH VOLTAGE	This voltage is factory set to 2.53 volts per cell. This parameter is only used when VRLA TERM is set to ON. Once finish rate is reached, battery voltage will climb to this set point. Battery voltage will be held constant at 2.53 v/c until TIME AFTER GAS & TIME AFTER FIN are satified. The range is 0.100 to 3.150	
51. TIME AFTER GAS	Selects the time that the charger runs after the 80% point has been reached. This parameter is a termination timer and is only used when VRLA TERM is set to ON. The range is 00-01 to 06-00 The factory setting is 4:00 (4 hours)	
52. TIME AFTER FIN	Selects the time that the charger runs after the Finish Voltage of 2.53 vpc has been reached. This parameter is a termination timer and is only used when VRLA TERM is set to ON. The range is 00-01 to 06-00 The factory setting is 2:00 (2 hours)	
53. Finish Termination	Selects charge termination at start of finish phase (i.e., at the end of taper phase).	

BASIC TROUBLESHOOTING PROCEDURE

NOTE: In LTC with line contactor: To measure voltages, the contactor must be pulled in. To do this, jumper Pins 6 and 7 of PC board connector J3.

1. Visually inspect all connections and components for signs of overheating, loose connections, improper connections, or damage. (Don't forget the transformer terminal strip connections.)
2. Verify that the transformer AC taps are in their proper positions.
3. Measure and verify the transformer voltages. All values should be within 10% of those in the next 3 tables. Readings of the phases should be within 1.5% of each other. For example, the value measured between terminals 2 and 3 for Phase A, Phase B, and Phase C must all be within 1.5% of each other. Also, measurements between terminals 1 and 2 should be the same as measurements between terminals 4 and 5; measurements between terminals 2 and 3 should be the same as measurements between terminals 5 and 6, etc.

NOTE: If a transformer is replaced, make absolutely sure that power wires 9A, 9B, and 9C and control wires 7A, 7B, and 7C are connected to the proper locations per the schematic wiring diagram
NOTE: Steps 4, 5, and 6 determine whether the transformer and associated wiring is functioning properly.

4. Measure and verify the voltages at the bottom of fuses F5, F6, F7, and F8. These fuses are located in the upper-left corner, top row of fuses. The leftmost fuse is F5. All values should be within 10% of those on the following tables.
5. Measure and verify the voltages at connector J2. All values should be within 10% of those on the following tables.
6. Measure and verify the voltages of the heatsinks. All values should be within 10% of those on the following tables.
7. If a DC fuse has opened, check:
   a. Battery and charger connector polarity,
   b. Loose DC assembly,
   c. Shorted SCR/Diode Block
8. If an AC fuse has opened, check:
   a. Transformer taps,
   b. Shorted SCR/Diode Block and,
   c. current balance between the 3 SCR/Diode Blocks (check with a clamp on AC ammeter). All currents should be within 10% of each other. If any SCR/Diode Block is zero, an open component or loose connection may exist.
9. Verify that the battery has the proper voltage rating and the proper ampere hour (AH) rating for your charger's range.
10. Verify that when a battery is connected to the charger, full battery voltage appears at PC board connector J4, pins 1 and 4 with pin 4 positive.
11. With the charger running, verify that the DC voltage at PC board connector J4, wires Y1 and Y2, is the same as the DC voltage across the shunt (10-75 mV, depending on the DC current output).

WARNING:	Do not try to measure battery voltage between Pins 3 and 4 of Connector J4. Shorting these pins is the same as shorting the battery terminal.

12. After a charge cycle successfully ends, disconnect the battery, and measure the voltage across the positive and negative charger terminals. This should measure less than 5VDC. If it is 5VDC or greater, an SCR/Diode Block may be leaky. Test your SCR/Diode Blocks as described in the *Testing Components* section.

The power circuitry is functioning properly if no problems were found after going through the above steps. If a problem is still present after going through these steps, look carefully for loose connections. If there is still a problem then the trouble is probably in the PC board or program.

Terminal Board Voltages

Terminals	AC Line Voltage (volts)		
(on each phase)	480 Vac, 60 Hz	600 Vac, 60 Hz	440 Vac, 50 Hz
1-2 4-5	208 +/- 10%	275 +/- 10%	160 +/- 10%
2-3 5-6	32 +/- 10%	25 +/- 10%	60 +/- 10%
1-3 4-6	240 +/- 10%	300 +/- 10%	220 +/- 10%

NOTE: These values are dependent upon the actual line voltage.

Fuse Voltages (F5-F8)

Connect Bottom of these Fuses	AC Line Voltage (volts)
Fuse F8 to Fuse F7	10 +/- 10%
Fuse F8 to Fuse F6	10 +/- 10%
Fuse F8 to Fuse F5	10 +/- 10%

NOTE: These values are dependent upon the actual line voltage.

Wire Voltages of Connector J2

Wires AC At J2	Line Voltage (volts)
X1 to X2	10 +/- 10%
X1 to X4	10 +/- 10%
X1 to X6	10 +/- 10%

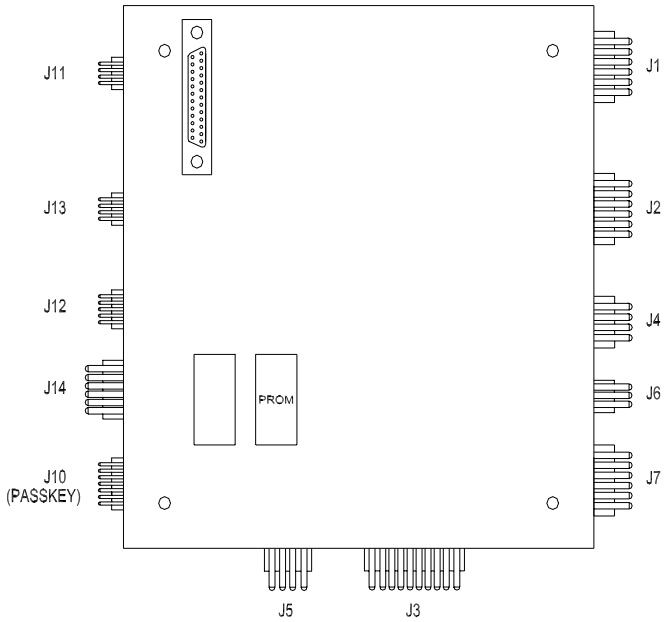
NOTE: These values are dependent upon the actual line voltage.

SCR/Diode Block Input Voltages

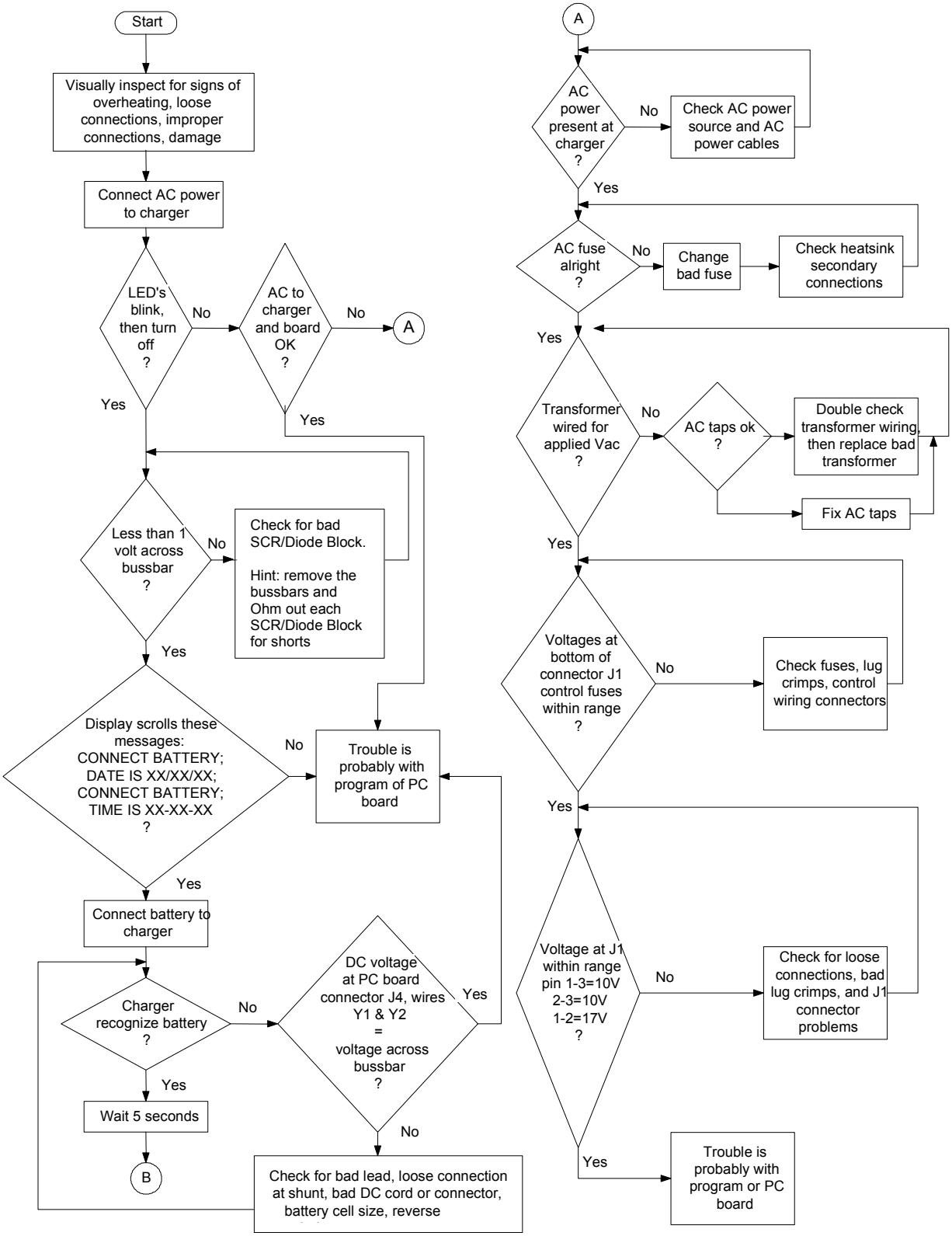
Measure between These SCR/Diode Blocks	AC Line Voltage
Left SCR/Diode Block to center SCR/Diode Block	2.35 v/c-AC +/- 10%
Left SCR/Diode Block to right SCR/Diode Block	2.35 v/c-AC +/- 10%
Center SCR/Diode Block to right SCR/Diode Block	2.35 v/c-AC +/- 10%

NOTE: These values are dependent upon the actual line voltage.
NOTE: 2.35 v/c-AC multiplied by the number of cells = total AC voltage.

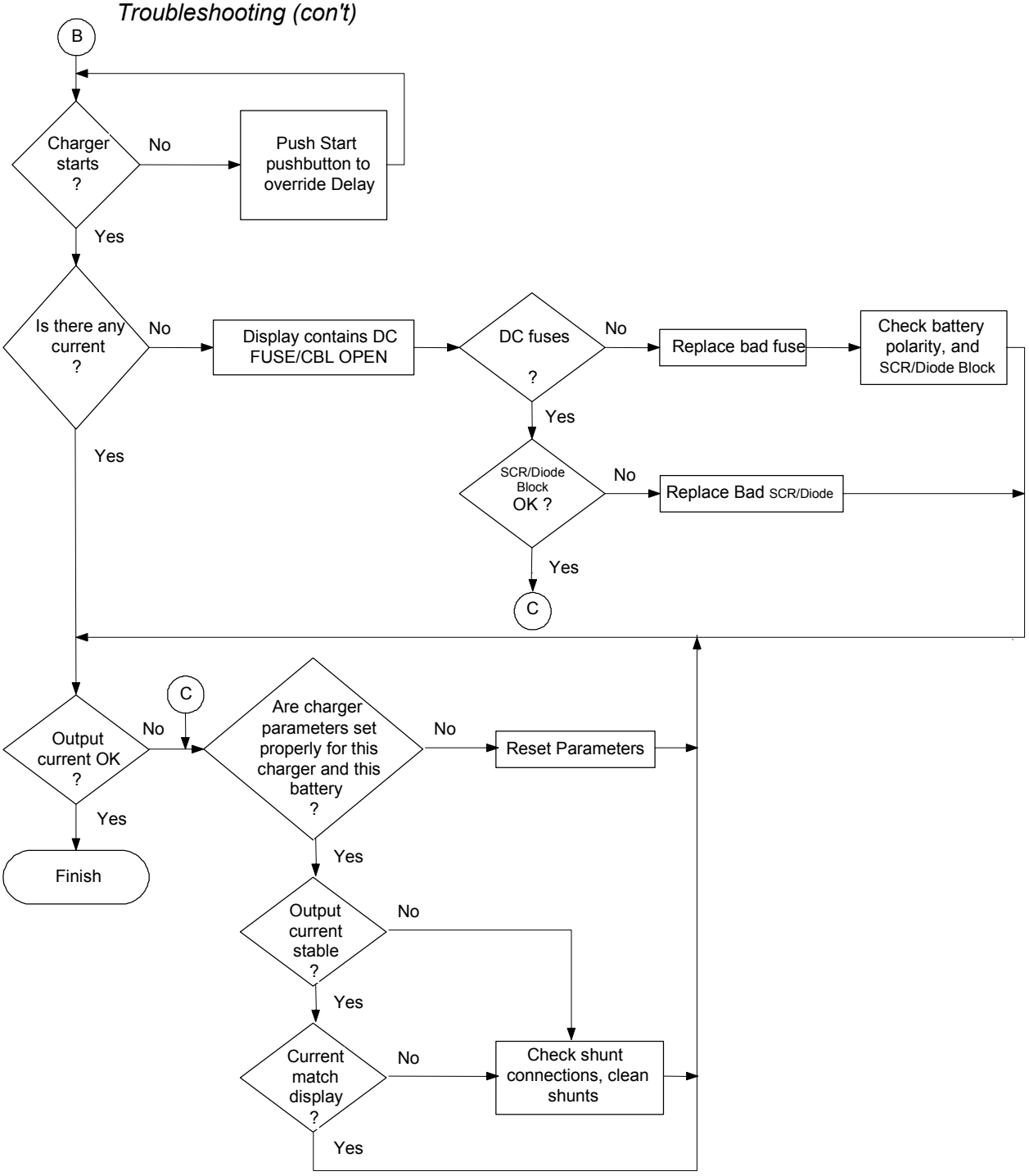
Printed Circuit Board



Troubleshooting



Troubleshooting (con't)



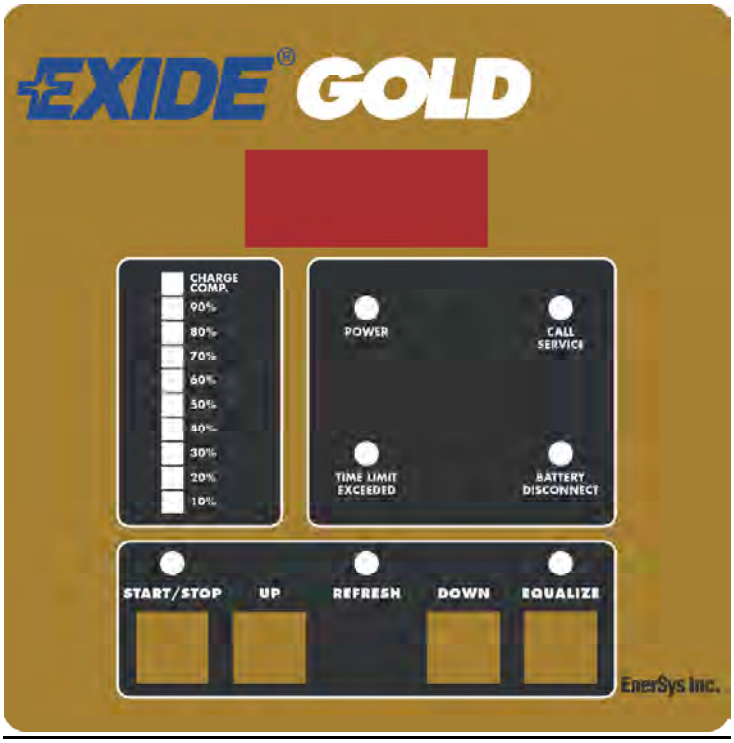
SYMPTOMS, SUGGESTIONS, AND REMINDERS

1. If the DC fuse is continually opening:
   a. One of the SCR/Diode Blocks may be defective,
   b. May have loose shunt wires,
   c. Verify that the Start-Rate current is set properly (Service-Level parameter START AMP).
   d. Worn connectors on DC cables.
2. If the charger is faulting START TIME EXCED or MAX CHG TIM OVER, and Service-Level parameter MAX STIM is set to 6 hours:
   a. This may be a hot battery, if it is not
   b. Try changing Service-Level parameter MAX STIM to 8 hours.
3. If, every time you begin a charge cycle, there is a phase loss as the charger tries to start up and then the charger appears to correct itself (LEDs blinking, indicating a fault detection then a fault correction):
   a. The 2 lugs at the bottom of each input fuse may not be secured properly under the screws,
   b. The transformer double wires (for example, wires #2 and #5) may not be properly inserted into the AC terminal blocks.
4. To protect from overcharging, be sure that:
   a. Start-Rate and Finish-Rate currents are set properly (Service-Level parameters START AMP and FINISH AMP),
   b. Gassing-Voltage point (Service-Level parameter 80% V/CEL) is not set too high,
   c. Time limits are set properly,
   d. Refresh (Service-Level parameter REF WAIT) is not too frequent.
5. To protect from undercharging, be sure that:
   a. Finish-Rate current (Service-Level parameter FINISH AMP) is not set too low (Finish-Rate = 4.5% rated capacity of the battery),
   b. Start-Rate current (Service-Level parameter START AMP) is set to your charger's nameplate rating.
6. If the AH rating of the battery is smaller than the AH rating of the charger:
   a. Finish-Rate (Service-Level parameter FINISH AMP) and Start-Rate (Service-Level parameter START AMP) currents must be adjusted downward for the AH rating of that battery. (Finish Rate = 4.5% rated capacity of the battery, Start Rate =16% rated capacity of the battery).
7. If the AH rating of the battery is greater than the AH rating of the charger:
   a. NOTE: If the AH parameter is changed, new START AMPS (16A/100AH) and new FINISH AMPS (4.5A/100AH) are calculated and the charger parameters are automatically updated.
   b. Be sure that the Start-Rate current (Service-Level parameter START AMP) does not exceed the charger's nameplate rating.
   c. Finish-Rate current (Service-Level parameter FINISH AMP) will need to be adjusted upward for the AH rating of that battery. (Contact technical support before performing an upward adjustment on the Finish-Rate current.)
8. To stop or pause a charge:
   a. Push the Stop push-button, and then disconnect the battery.
   b. To only pause the charge, leave the battery connected, the charge will continue from where it left off when the charger is started again.
9. During an AC power failure:
   a. Key information concerning the charge cycle is saved electronically. When power returns, this information is automatically retrieved, and if a battery is connected to the charger, charging automatically continues from where it was interrupted, protecting the battery from being overcharged.
   b. NOTE: If a battery is connected to the charger at the moment power returns, the charger assumes that this is the same battery that was connected to it when the power failure occurred.
10. If the battery is disconnected during a charge cycle:
    a. The CHR will turn itself off, and fault message, DC FUSE/CBL OPEN usually appear on the display.
11. To stop an equalize cycle (when the Equalize LED is lighting steadily):
    a. Push the Stop push-button and unplug the battery.
12. If you are installing cables that are longer than the normal 8 feet:
    a. Be aware that this will cause a voltage drop of about 1/2 volts per 10 feet at Start-Rate current.

b. Be sure to set Service-Level parameter CABLE, so that the charger can determine the voltage drop. (The charger comes with 8 feet of cable, 10 feet of positive and 10 feet of negative).

13. There is a Charge Override:
    a. Shorting together pins 1 and 2 of PC board connector J5 will stop a charge in progress, blank the display, and turn off the LEDs.
    b. When the pins are opened, a new charge cycle will begin.
    c. No data from the overridden charge cycle will be saved.
14. Chargers are specifically built for 50 or 60 Hz, not both.
    a. A 50 Hz model cannot be converted to a 60 Hz model.
    b. A 60 Hz model cannot be converted to a 50 Hz model.

D3G CONTROL BOARD



LED	
POWER	Light on when control board powered.
CALL SERVICE	Light on when serious fault occurs during charge cycle, usually requiring field assistance.
TIME LIMIT EXCEEDED	Light on when charger time fault occurs.
BATTERY DISCONNECTED	Light on when battery disconnected during charge cycle before normal termination.
START/STOP	Light on during charge cycle. Light is off when charger is stopped or charge cycle terminates.
REFRESH	Light on during refresh cycle.
EQUALIZE	Light flashes when an equalize cycle is pending. Light on during and after the actual equalize cycle. Light is reset when battery is disconnected from charger.
BAR GRAPH	Shows capacity returned to battery during charge cycle.
Pushbutton	
START/STOP	Stops a charge in progress or restarts a charge that has been stopped. Can also force a charge cycle by pushing and holding for 5 seconds.
EQUALIZE	Will activate the equalize function at any time during the charge cycle. The equalize button is also used for programming the charger.
UP	Used to scroll through charge cycle data when charger is idle. Also used to scroll up through charger settings in programming mode.
DOWN	Used to scroll through charge cycle data when charger is idle. Also used to scroll down through charger settings in programming mode.

D3G AND GTX CHARGERS

The D3G / FGTX chargers are factory set for Flooded. The GTX / SD3G chargers are factory set for Sealed.

CHARGER FEATURES

GENERAL

The standard D3G/GTX charger has a wide range of charging features for both flooded and sealed cell batteries. The D3G and GTX are capable of charging various cell sizes and ampere hour ratings as listed on the charger nameplate. Some of the basic features are described below.

MULTIPLE BATTERY SELECT

A total of 5 completely different battery profile selections can be stored and quickly selected for the customer that has multiple battery types and sizes.

AUTO START/DELAYED START

Auto Start enables the battery charger to start the charge cycle automatically after the battery is connected to the charger. A programmable delay can be programmed so that Auto Start will begin after a set time period. This delay can be set through the front panel display, refer to ***d-St*** in section **USER PARAMETER CONFIGURATION**. Auto start can be delayed anywhere from 0 up to 25 hours, in one minute intervals.

AUTO EQUALIZE CYCLE

An Equalize Cycle adds a predetermined amount of time to extend the battery's charge cycle. This charger is equipped with an Auto Equalize function. This is a configurable parameter; consult your service representative for more information. The factory default setting for the Auto Equalize cycle is 3 hours of charge time for every fifth charge cycle. A charge cycle consists of a least one hour of continuous charging of the battery by the charger. Every time the battery completes a charge cycle, the charge equalize cycle will occur immediately after the battery completes its normal charge cycle. When an equalize charge cycle is pending, the **EQUALIZE** LED will flash. The Equalize button can be pressed at any time during the normal charge cycle to stop the pending equalize cycle. Once the battery has completed a successful charge cycle, the **CHARGE COMPLETE**LED will light and the charger will immediately go into the equalize charge cycle. The **EQUALIZE** led WILL THEN LIGHT STEADILY. Pressing the Equalize button during the equalize charge cycle will have no effect on the charger.

MANUAL EQUALIZE CYCLE

The charger can also equalize a battery manually. Pressing the EQUALIZE pushbutton at any time during the charge cycle will activate the equalize function. Once pressed, the **EQUALIZE** LED will begin to flash indicating that an equalize cycle will occur once the battery has completed a successful charge cycle. The EQUALIZE pushbutton can again be pressed at any time during the normal charge cycle to stop the pending equalize cycle. The CHARGE COUNTER is reset every time the battery completes a successful equalize charge cycle. Pressing the EQUALIZE pushbutton during the equalize charge cycle will have no effect on the charger.

> **NOTE:** Since Equalize charging extends the recharge time; it is best to do this when additional cooling time is available (example: on a weekend). Consult your factory representative to determine Equalize intervals that meet your needs.

AC POWER FAIL

AC power may fail with a battery connected to the charger during a charge cycle. When AC power returns with the battery connected, the charge cycle will resume the battery charging after a random delay. The charger will also detect an AC fuse open resulting in a stopping of the charge and a fault code displayed.

REFRESH CYCLE

If a battery remains connected to the charger for a predetermined amount of time after a charge cycle has been completed, a refresh charge cycle will be given to the battery. The factory default setting for the Refresh cycle is to refresh for 20 minutes every 24 hours. This is a configurable parameter; consult your service representative for more information.

COOL DOWN

When a battery completes a charge cycle without error, it ideally should cool down before being used. This is a configurable parameter that can be set through the front panel display, refer to ***c o o L*** in section User Parameter Configuration. The factory default setting for the Cool Down is 1 hour.

PARALLEL CHARGING (OPTIONAL)

In parallel charging, batteries must have an equal number of cells and must match the charger nameplate's ratings. Amp-Hour rating of charger must be equal to the Amp-Hour of both batteries combined. Theoretically, charging current is equally divided between both batteries provided that batteries percentage of discharge and ages are equal. Make sure both batteries are connected before charge cycle starts. The charger must be set for parallel cable and have Auto Cell sizing disabled in the service settings. Contact your sales/service representative.

SERIES CHARGING (OPTIONAL)

In series charging, the voltages of both batteries add up and must match charger's nameplate rating. Charger's Amp-Hour rating must be equal to each of the batteries Amp-Hour rating. Charge cycle will not start unless both batteries are connected.

AC DISCONNECT (OPTIONAL)

When an AC disconnect is installed, access to the charger through the front door is denied unless the AC disconnect is switched off. When the AC disconnect is in the off position, power is only present at the disconnect switch input terminals. Make sure that main breaker is switched off before working on the charger.

AC INPUT CHANGE QUICK TAP™ (OPTIONAL)

Quick Tap™ is a feature to EnerSys chargers that allows the user to change AC input easily and quickly. See the heading VOLTAGE CONVERSION FOR MORE INFORMATION.

NORMAL OPERATION

1. There are no jumper selections, pot adjustments, or slide switch selections on the D3G/GTX control board. All parameters are programmed via User or Service level parameters. There are no pots for calibration. Board calibration is done at the factory only.

2. Idle Mode: When AC input voltage is applied to the charger and no battery is connected, the **POWER** LED will be lit. The message will display in rotation on the front panel display:

   Conn / Bat#

   where Bat# is the selected battery settings 1-5.

3. During Idle Mode, toggling the UP or DOWN pushbuttons will display the previous charge cycle parameters. Toggle the UP or DOWN to display the total charge time, Amp-hours delivered, highest voltage during the previous charge cycle, the number of charge cycles since the last equalize and the equalize count. Only the charge count and equalize count remains in non-volatile memory. These values will be saved even when AC power is removed. The other values will remain in volatile memory until the next charge cycle begins or if AC power is removed.

4. Plug the battery connector into the charger connector. The control board senses voltage. Once the battery is connected to the charger, the **START/STOP** LED will flash for approximately 5 seconds while the display shows this message:

   Strt
   ## Cell
   #### AH
   Fld
   3
   2
   1
   Strt

   Charging will begin. The **START/STOP** LED will light steadily.

5. The LED bar graph will indicate the percent charged status of the battery and the display will now begin to show:

####.#	(Charger output current)
####	(Amp-hours returned)
##.##	(Charge Time)
#.###	(Cell Voltage)

   These values are displayed in rotation for about 3 seconds each. The display can be changed so that current or voltage, or current and voltage or all the above will be displayed. The default setting is for all the above to be displayed.

CAUTION: To prevent arcing and burning at the connector and possible battery explosion, press the START/STOP pushbutton first to stop the charge cycle before removing a battery that is currently on charge.

6. When the battery reaches **Gassing Voltage**, the yellow **80%** LED will light and the charge current will begin to taper.

7. After the current tapers to the finish rate current, charging will continue until the battery voltage flattens or the time in taper equals 5 hours. If no Equalize charge is to be applied to the battery, the charger will stop and the display will read: ***done***.

   NOTE: If the battery is to receive an Auto Equalize charge, the charge cycle continues for 3 more hours at finish rate current and then stops with the reading: ***done***.

8. When the battery is fully charged the green **CHARGE COMPLETE** LED will light, the **START/STOP** LED will extinguish and the charger will shut off. At this time the battery is at full capacity and ready for use.

   If cool down is <u>not</u> selected, the display will read ***done*** when the charge is complete.
   If cool down is selected, at the end of charge the display will read
   Cool
   dn
   for the duration of the cool down period. After the cool down period has expired, the display will read ***done.***

   When the battery is disconnected, only the **POWER** LED remains lit and the display will alternate.
   Conn / Bat#
   The charge counter will increment by one for the completed charge cycle.

CHARGER FAULTS

The charger control circuitry constantly monitors for several fault conditions. If a fault should occur, the charge in progress is interrupted, and a fault message is displayed on the front panel. A list of the faults and their descriptions follow:

Parameter	Description	Fault LED	Fault Clearing
DC FuSE	Occurs when the DC fuse opens or no DC output current	Call service – YES Bar Graph – Flashes	Can be reset by disconnecting the battery from the charger. Replace fuse or troubleshoot.
OPEn batt	Occurs when a charging battery is disconnected from the charger without first stopping the charge cycle.	Battery Disconnect - YES Bar Graph – Steady On	Can be reset by connecting a battery to the charger.
t-1 Err	Occurs when the time limit to gassing voltage is exceeded.	Time Limit Exceeded Bar Graph – Steady On	Can be reset by disconnecting the battery from the charger.
t-2 Err	Occurs when the overall charge cycle time limit is exceeded	Time Limit Exceeded Bar Graph – Steady On	Can be reset by disconnecting the battery from the charger.
t-3 Err	Occurs when the time limit after gassing is exceeded.	Time Limit Exceeded Bar Graph – Steady On	Can be reset by disconnecting the battery from the charger.
Lo batt	Occurs when the battery is first connected and the voltage is between 1.0 and 1.8 volts/cell.	Call Service – NO Bar Graph – Steady On	Reset if battery voltage is between 1.8 and 2.4 volts/cell.
Hi batt	Occurs when the battery is first connected and the voltage is above 2.4 volts/cell	Call Service – NO Bar Graph – Steady On	Will automatically reset if battery voltage is between 1.8 and 2.4 volts/cell.
Hot batt	Occurs when there is negative change in battery voltage.	Call Service – NO Bar Graph – Steady On	Can be reset by disconnecting the battery from the charger.
High AH	Occurs when more than 150% of battery Amp-Hours are returned during the charge cycle.	Call Service – NO Bar Graph – Steady On	Can be reset by disconnecting battery from the charger
AC fLt	Occurs when AC fuse is blown or a phase of AC power is interrupted.	Call Service – NO Bar Graph – Steady On	Can be reset by disconnecting battery from the charger. Disconnect AC power & check AC source.

MULTIPLE BATTERY SELECT

A total of 5 completely different battery profile selections for both USER and SER parameters can be chosen. The default for the charger is to have this feature shut off so that only a single battery selection can be made. Multiple battery selection can be enabled in service parameters.

USER PARAMETER CONFIGURATION

ADJUSTING SETTINGS

The charger's user parameters may only be configured while the charger is in idle mode. Press the EQUALIZE pushbutton and hold for approximately 5 seconds. If multiple battery select is disabled (default) in service parameters, skip the following paragraph.

ADJUSTING BATTERY SELECTION

With Multiple Battery Select Enabled

After holding the EQUALIZE pushbutton in for 5 seconds, the display will read ***UsEr*** and is now ready for battery selection. Release the EQUALIZE pushbutton the display now reads ***Set***. Use the UP and DOWN arrows to scroll through the battery selection from 1-5. By selecting a different battery, an entirely new set of charging parameters can be selected while saving the previous setting. Contact your local sales/service representative to install alternate battery settings. When the correct battery is chosen, press the START/STOP pushbutton to exit the selection process and enter into User parameters. The display will now show ***disp***.

ADJUSTING USER SETTINGS

With or without Multiple Battery Select Enabled

For a list of available user parameters and their definitions, see the table below.

The display shows ***diSP.*** You can scroll up through the different parameters by using the EQUALIZE pushbutton. To adjust the user parameters press the UP or DOWN pushbuttons. If you press and hold the UP or DOWN pushbuttons for 3 seconds when adjusting the parameters, the options will scroll through at a rapid pace. Release the pushbutton to return to normal scrolling mode. When finished adjusting parameters, press the START/STOP pushbutton to exit the user parameter configuration mode and save the parameter settings. The display will now read ***CONN BATT***.

Parameters	***DESCRIPTION***	Range	Default
diSP	Display mode 3 = displays current, A-H returned, charge time and battery voltage. 2 = displays current and voltage only. 1 = displays current only 0 = displays voltage only	0-3	3
d-St	**DELAYED START** Amount of time delay after a battery is connected to the charger before charging proceeds. Increments in 1 minute intervals.	0 min – 25 hr	.00
CooL	**COOL DOWN TIME** Amount of time after a complete charge cycle that a battery needs to cool down before being utilized.	0 hr – 12 hr	1.00 hr
EU-C	**EQUALIZE COUNTS** Total amount of charge cycles that need to occur before an automatic equalize charge cycle will take place. (0 indicates that no Equalize charge will occur)	0-20 charge cycles	5 charge cycles

When Multiple Battery Select is enabled, the customer can easily select between 5 completely different battery profiles by simply pressing and holding the Equalize button for 5 seconds. Choose the particular battery setting by scrolling the UP or DOWN arrows after the display reads ***Set.*** Changing the service parameters will apply only to the particular battery that is selected. After the particular group of settings are chosen press the START/STOP button twice to exit battery select mode.

When setting service parameters for Multiple Battery Selection DO NOT exceed the charger nameplate cell size or amp hour rating.

.**SERVICE PARAMETER CONFIGURATION**

ADJUST BATTERY SELECTION

Choose the particular battery settings to be modified. Note that changing the service level parameters for a particular battery selection will not affect the parameters for other battery selections.

ADJUSTING SERVICE PARAMETER SETTINGS

Only while the charger is in idle mode, the charger's service parameters may be configured. In order to do so, press the DOWN and EQUALIZE pushbuttons simultaneously and hold for approximately ten seconds. The display will read ***SEr*** and is now ready for service parameter configuration. When you release the DOWN and EQUALIZE pushbuttons the display will then read ***Cell***. For a list of available user parameters and their definitions, see the table below.

You can scroll up through the different parameters by using the EQUALIZE pushbutton. To adjust the service parameters press the UP or DOWN pushbuttons. If you press and hold the UP or DOWN pushbuttons for 3 seconds when adjusting the parameters the options will scroll through at a rapid pace. Release the pushbutton to return to normal scrolling mode. When finished adjusting parameters, press the START/STOP pushbutton to exit the parameter configuration mode and save the parameter setting. The display will now read ***Conn / Bat#***. Only the service parameters for the particular battery selection # have been modified.

DEFAULT SETTINGS

Parameter	*Description*	*Range*	*Default*
Cell	**CELL SIZE** This is the number of cells that the charger is designed to charge. This parameter should be set to match the cell size rating on the charger nameplate. This parameter is important for cable drop compensation.	1-40	18
C-AH	**CHARGER AMP HOUR RATING** Nameplate amp-hour rating of charger.	10-2500 AH	850
t-80	**TIME TO GASSING** Amount of time before gassing voltage is reached. If this time limit is exceeded before reaching gassing voltage, a fault occurs	1 hr – 12 hrs	6 hrs
t-Lt	**TIME LIMIT** Maximum amount of charge cycle time in which a charge cycle is to be completed. If this time limit is exceeded before the charge cycle completes, a fault occurs.	2 hrs – 18 hrs	18 hrs
t-rf	**REFRESH TIME** Amont of time allotted for a refresh charge cycle.	0-60 mins	20 mins
rf-I	**REFRESH INTERVAL** Amount of time between when a charge cycle completes and a refresh cycle begins. A refresh cycle will occur at the interval until the battery is disconnected from the charger.	2 hrs – 99 hrs	24 hrs
t-EU	**EQUALIZE TIME** Amount of time that a charged connected battery will remain in an equalize charge cycle.	6 mins – 10 hrs	3 hrs
80	**GASSING VOLTAGE (80% POINT)** Battery voltage in Volts/Cell that is needed in order to indicate that the gassing voltage (80% point) is reached and will light the 80% LED.	1.000-3.000 V	2.370 Volts
-dt	**-dt** Amount of voltage in mV/cell that the battery voltage must drop after the gassing voltage is reached in order to give a Hot Batt error. Can only occur when the termination method is set to TV, or in an equalize cycle.	0 mV – 100 mV	20 mV
Up-t	**UP TIME DETECT** The programmed time for the battery voltage to stabilize, before the charger determines its state of charge.	0 min – 10 mins	2 mins
Cb-L	**BATTERY CABLE LENGTH** Length of battery cables installed on the charger – used in battery cable drop compensation calculations. Length is entered in inches.	1-2400	120
Cb-t	**BATTERY CABLE TYPE** Size of battey cable: 1 = 4/0 cable 2 = 3/0 cable 3 = 2/0 cable 4 = 1/0 cable 5 = #2 cable	1-5	8
Cb-C	**BATTERY CABLE CONFIGURATION** This parameter configures the controls to the configuration of the battery cables for the purposes of calculating the battery cable drop compensation: 0 = Cable drop compensation disabled 1 = Standard cable 2 = Dual parallel cables	0 – 2	1
ter	**TERMINATION METHOD** 1. DVDT – Terminates after no change in voltage is detected in the battery. 2 . TV – Terminates 5 hours after the 80% (gassing voltage) is reached. 3. Both – Either DVDT or TV, whichever occurs first. 4. Proportional 5. Amp-Hour (set Battery AH)	1-5	3
E-dt	**EXTENDED DVDT** An extended time period added to DVDT termination for prolonging the charge cycle.	0 hrs – 4 hrs	0
TA80	**TIME AFTER 80%** The maximum amount of time the battery charge cycle will continue after the gassing voltage is reached.	0 hrs – 10 hrs	5 hrs
P-Fc	**PROPORTIONAL FACTOR** The amount of time the charge cycle remains in taper and finish mode as a percentage of the start mode time.	0 – 100%	40
Parameter	***Description***	***Range***	***Default***

Fn-A	**FINISH CURRENT** Finish amps. This parameter is automatically derived when setting the battery amp-hours and charge profile. Can also be set directly.	1 – 200 A	38
St-A	**START CURRENT** Start Amps. This parameter is automatically derived when setting the battery amp-hours. Can also be set directly.	1-400 A	136
Ch-P	**CHARGE PROFILE** Flooded or Sealed Profile 1 = IEI (Flooded) 2 = IEIE (Sealed) Note that changing the setting will also change the Finish Current	1-2	1
S-Fn	**SEALED FINISH VOLTS** VRLA finish voltage	1.00 – 3.00 Vpc	2.53
S-Ft	**SEALED FINISH TIME** VRLA finish time	0-12 hrs	2
b-AH	**BATTERY AMP-HOURS** Set battery amp-hours for start rate and finish rate determination. Also used for amp-hour termination and for excessive amp-hour faults.	0-2500 AH	850
E-bS	**BATTERY SELECT ENABLE** 0 = Battery Select Disabled (must set cell size) 1 = Battery Select Enabled	0-1	0
E-rd	**RANDOM DELAY ENABLE** Enables / Disables random delay start after an AC power outage. 0 = disabled 1 = enabled	0-1	1
E-dp	**DISPLAY ENABLE** Allows modification of Display mode in User parameters 0 = disabled 1 = enabled	0-1	1
E-ds	**DELAY START ENABLE** Allows modification of Delay Start in User parameters. 0 = disabled 1 = enabled	0-1	1
E-Co	**COOLDOWN ENABLE** Allows modification of Cooldown time in User parameters. 0 = disabled 1 = enabled	0-1	1
E-Ec	**EQUALIZE COUNT ENABLE** Allows modification of Equalize count in User parameters 0 = disabled 1 = enabled	0-1	1
totL	**TOTAL CHARGES** Total count of every charge cycle greater than one hour that terminates normally. This parameter is <u>not</u> modifiable.	0-9999	-

DEFAULT SETTINGS

1. Remove power to the control board.
2. Before applying power to the board, hold down the UP and DOWN pushbuttons.
3. Reapply power. Hold down the UP and DOWN pushbuttons, for approximately five seconds, until the display reads ***dflt***.
4. Release the UP and DOWN pushbuttons.
5. All battery profile settings will now be reset to the original default settings.

FIELD CALIBRATION

No field calibration is necessary. All control boards are factory calibrated. No pots or adjustments are available. Return all failed or defective boards to the factory.

RECHARGE CHARACTERISTICS

When a charge cycle begins, constant current is applied to the battery (start current mode). This constant current is called start rate current.
When the gassing voltage point (80% charge voltage of 2.38 volts/cell) is reached, the charger stops applying constant current, and starts applying constant voltage (constant voltage mode).

GASSING VOLTAGE POINT NOT REACHED

If the gassing voltage point is not reached during the time allotted (which is factory set for 6 hours), the override timer will time out and shut down the charger.

GASSING VOLTAGE POINT REACHED

When the gassing voltage point is reached, the override timer resets and timing begins again for constant voltage mode.
During constant voltage mode, the current tapers down to approximately 4.5 amps per 100 AH. At this point, the charger stops applying constant voltage and returns to applying constant current (finish current mode). This constant current is called finish rate current.

FINISH CURRENT MODE NOT REACHED

If the finish current mode is not reached during the time allotted, the override timer will time out and shut down the charger.

FINISH CURRENT MODE REACHED

If the finish current mode is reached, the charger will continue charging until termination time is reached.

EQUALIZE MODE

If this is an Equalize charge cycle, the charger will complete the finish current mode, and then enter Equalize mode where it will equalize all the cells in the battery. It is recommended that every fifth or sixth charge cycle be an equalize cycle (check with battery engineering).
During Equalize mode the charger applies constant current at the same rate as the current in finish current mode. The Equalize mode adds 3 hours to a daily charge cycle.

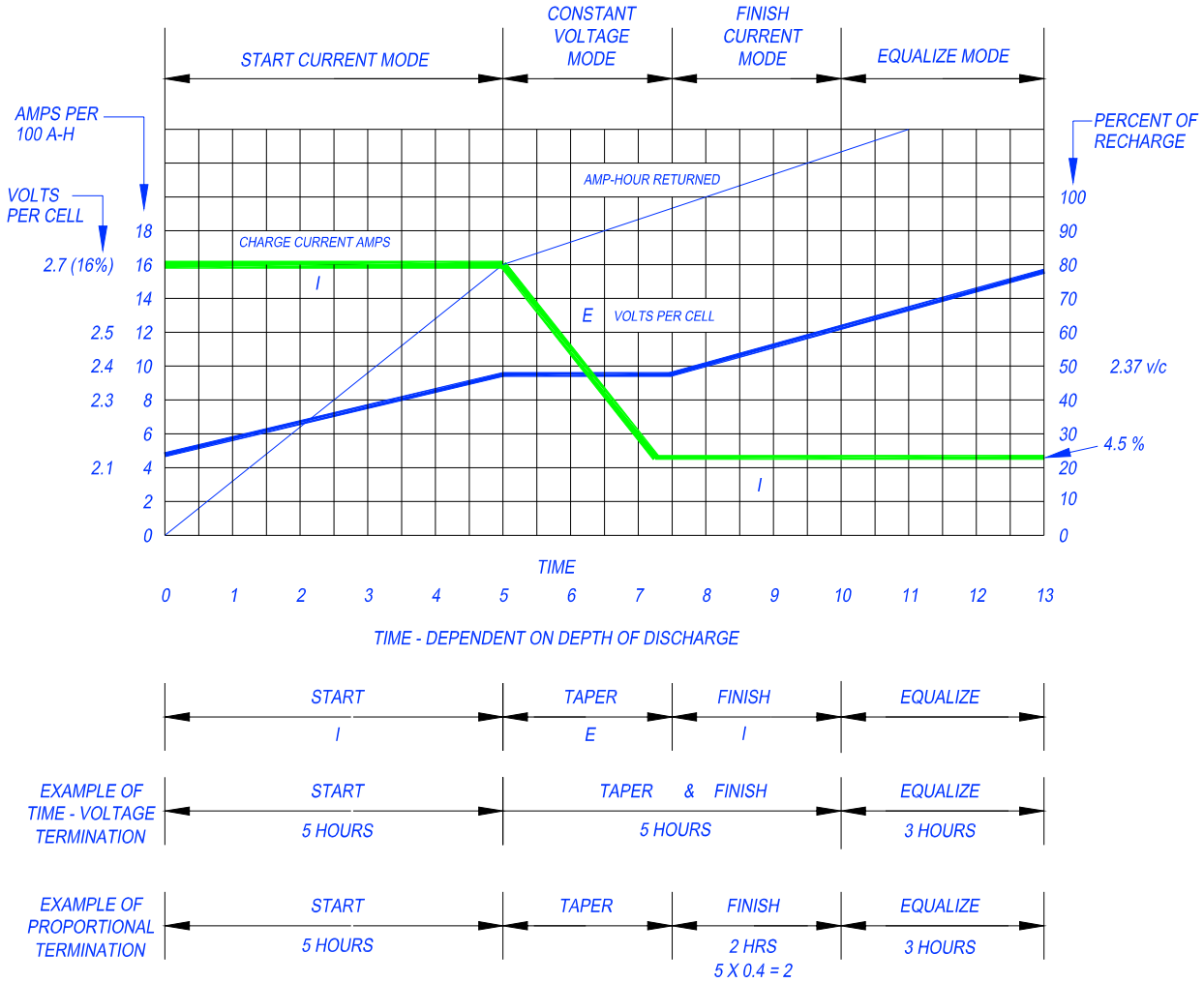
REFRESH MODE

Refresh mode will be entered after the charge cycle has completed, if the battery is left connected to the charger for the period of time specified. Refresh Wait period is factory set for 24 hours. A refresh charge assures that the battery is fully charged.
During Refresh mode the charger applies constant current at finish setting. The time spent in Refresh mode is specified. Refresh Charging time is factory set for 20 minutes.

CHECKING THE RECHARGE CHARACTERISTICS

You can check the battery voltage during start current mode on a **discharged** battery. The battery voltage should gradually increase to 2.37 volts/cell (v/c) with the charging current at 16% of the charger nameplate rating.
Example: If you are using a 550 AH charger, the charging current during start current mode will be 16% of 550, which is 88 amperes.
The output voltage terminals can be checked during constant voltage mode. The battery voltage should be steady at 2.37 v/c ± 1%, and the charge current should gradually decrease.
The battery voltage can be checked during finish current mode. The battery voltage should measure at least 2.37 v/c at a constant current of 4.5% of the charger nameplate rating.

Recharge Characteristics



Testing Components (all chargers)

The following information applies to all chargers types, unless otherwise noted.

TRANSFORMER

Please follow these steps before testing the Transformer:

Disconnect the battery.
Remove the charger cover.
Connect the charger to AC power.

First Transformer Test

You will be testing the transformer's windings (with a good quality meter) to check the transformer's voltages. Your measurements should be within 10% of what is listed on the nameplate.

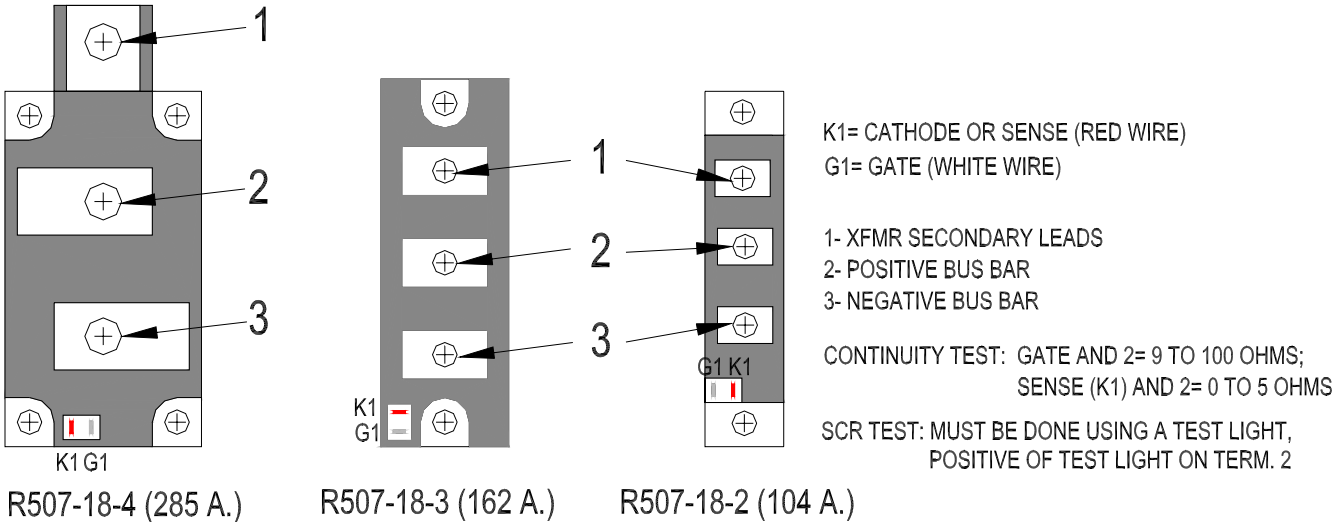
Second Transformer Test (120V Test)

Be sure to disconnect the transformer from SCR/Diode Block, PC board, and control transformer primary. You will need to have the transformer isolated for this test.

1. Use a line cord with a 3 to 5 amp slow-blow fuse in an in-line fuse holder.
2. Power each section separately. Power from TB #1 and #6, and jumper leads 3 and 4.

3. If a fuse has opened, there might be a winding problem in the transformer. Perform all other tests in this section before replacing the transformer.

SCR/DIODE BLOCK



WARNING: Faulty SCR/Diode Blocks may cause voltage to be present at the DC cables.

Physical Test

If you do not have a clamp-on meter to check for current in the 3 SCR/Diode Blocks, you can perform the following to locate a fault in the secondary phase:

1. Start the charger, and run it for 5 minutes with a battery connected.
2. Then turn off the charger and disconnect the battery.
3. Within 1 minute, check the temperature of the SCR/Diode Blocks. If an SCR/Diode Block is cold, then it is defective.

WARNING: Heatsink and SCR/Diode Blocks may be very warm. Please exercise caution.

First SCR/Diode Block Test

Please follow these steps before testing the SCR/Diode Blocks:

Disconnect the battery.
Disconnect the AC power.

You will be testing the SCR/Diode Blocks to see whether there is continuity or forward leakage current (100k ohms or less).

1. Disconnect the gate leads from SCR/Diode Blocks.
2. Remove the transformer-input connection to the SCR/Diode Block (anode).
3. Using an ohmmeter, set to its 1k scale, check for continuity between each SCR/Diode Block (anode) input connection and + bussbar. The ohmmeter should read infinity.
4. If continuity is shown, replace the SCR/Diode Block.
5. If infinity (open) is measured in both directions, the SCR/Diode Block may be open. To prove the SCR/Diode Block functions properly, you need to go to the next test (Second SCR/Diode Block Test) to check the gating operation of the SCR/Diode Block.

Second SCR/Diode Block Test

Please follow these steps before testing the SCR/Diode Block:

Disconnect the battery.
Disconnect the AC power.

You can test a single SCR/Diode Block at a time. You will need a Flashlight tester or a Continuity tester with 2 AA batteries in it to do this.

Please follow these steps:

1. Disconnect the three phase input wires to each of the SCR/Diode Blocks.

2. Disconnect the nylon connector from the SCR/Diode Block (gate drive).
3. Connect the negative potential of your tester to the positive bussbar.
4. Connect the positive potential of your tester to the input connection of the SCR/Diode Block under test. Then by using a jumper wire touch the SCR/Diode Block gate pin (white lead connects there) to the SCR/Diode Block input connection. The tester will light.

NOTE: If your tester lights before connecting to the SCR/Diode Block input, then the SCR/Diode Block is defective. Test one SCR/Diode Block at a time to find the faulty one(s).

a. Disconnect the jumper wire to the SCR/Diode Block gate pin. The tester should remain lit.
b. The SCR/Diode Block is defective if the tester did not remain lit.

DIODE TEST

Please follow these steps before testing the diode:

Disconnect the battery.
Disconnect the AC power.

You will be testing the diode to see if it is shorted.

1. Disconnect the three phase input wires to the SCR/Diode Blocks.
2. Use an analog meter set to its X1 scale, or use a DVM set to its diode scale.
3. Connect the meter's negative lead to the input connection of the SCR/Diode Block.
4. Connect the meter's positive lead to the - bussbar.
5. If you are using an analog meter, it should read close to 0 ohms.
6. If you are using a DVM, it should read a .7V drop on the diode scale.
7. Reverse the wires on the meter.
8. The needle should not move on the analog scale (measurement of infinity). The DVM should not get a reading.
9. The SCR/Diode Block is shorted if the meter measures zero current for both directions (polarities).
10. The SCR/Diode Block is open if the meter reads infinity for both directions (polarities).

AC AND DC FUSES

Please follow these steps before testing the fuses:

Disconnect the battery.
Disconnect the AC power.

You will be testing each fuse to see whether there is continuity across it.

1. Using an ohmmeter, set to its x1 scale, test each fuse.
2. If a fuse tests as an open circuit (infinity), replace it.
3. If there is continuity across the fuse (less than 1 ohm), it is working properly.

LEDs

To test if the LEDs are working,

1. Turn AC power off then back on.
2. When the power is turned on, all the LEDs should blink.

PC BOARDS (ALL)

Please follow these steps before testing the PC board:

Disconnect the AC power.

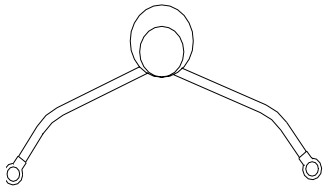
You will be testing the DC battery voltage on the PC board at connector J4, then verifying that this voltage is the same as the battery's voltage.

1. Connect your meter to Pin 1 (the square pad) of Connector J4 and to the opposite end (Pin 4).
2. Verify that you have voltage at the board.

WARNING:	We have specifically chosen Pins 1 and 4 because shorting battery voltage could cause damage

3. Now verify what you measured at the connector against actual battery voltage.

SNUBBER ASSEMBLY



Please follow these steps before testing the snubber assembly:

Disconnect the battery.

Disconnect the AC power.

The snubber assembly consists of a series resistor and a capacitor.

Before taking measurements on the Snubber assembly:

1. Verify that the mounting wire is sound--properly screwed on and not broken,
2. Verify that the Snubber assembly is not burned, broken, or smoking.

To test the snubber assembly,

1. Disconnect a mounting wire and check for no continuity.
2. Replace if your meter reads less than 200k ohms.

ID BOARD (LOAD HOG ONLY)

Please follow these steps before testing the ID board:

Disconnect the battery.

Disconnect the AC power.

Using the following table, test the pins on the ID board.

If your measurements are different than those in the table, replace the ID board.

Model	Pins	Ohms
12-680	1-2	open
	6-3	open
	6-4	open
	6-5	open
12-850	1-2	open
	6-3	short
	6-4	open
	6-5	open
18-550	1-2	51.1K
	6-3	open
	6-4	short
	6-5	open
18-1000	1-2	51.1K
	6-3	short
	6-4	short
	6-5	open

Model	Pins	Ohms
18-1600	1-2	51.1K
	6-3	open
	6-4	open
	6-5	short
24-1000	1-2	26.1K
	6-3	short
	6-4	open
	6-5	short
40-850	1-2	11.0K
	6-3	open
	6-4	short
	6-5	short

Measure the resistance across pins 1 and 2 on connector J14 of the PC board. You should measure k ohm resistance.

CONTACTOR (IF AVAILABLE)

First Contactor Test

Please follow these steps before testing the contactor:

Disconnect the battery.

On Connector J3, on the PC board,

1. Short pins 6 and 7.
2. The contactor should pull in.
3. If it does not, check the wiring from Connector J3 to the fuse and to the contactor.

Second Contactor Test

Please follow these steps before testing the contactor:

Disconnect the battery.

Disconnect the AC power.

Disconnect "J3" connector from the control board.

You will be testing the contactor to see if it is shorted.
1. Measure, in ohms, the resistance at the coil connections of the contactor.
2. If it measures infinity or zero, replace the contactor.

CONTROL TRANSFORMER (IF AVAILABLE)

Please follow these steps before testing the control transformer:
Disconnect the battery.
You will be testing the wiring of the control transformer for continuity.
1. Lugs 1 through 5 are located at the front of the control transformer, with lug 1 at the top.
2. Lugs 6 through 10 are located in the back, with lug 10 at the top.
3. Measure across the lugs specified in the ID Board (Previous table).
4. If what you measure does not correspond with what is listed in the table, replace the control transformer.

Lugs	J1 on control board	Measurement
1-5	---	Nominal charger input Vac +/- 10%
6-7	---	28 Vac +/- 10%
8-9	2-3	11 Vac +/- 10%
9-10	1-2	11 Vac +/- 10%

LED (D3E2/GTS SERIES)

With no battery and the AC applied:
To test the LEDs, push the Stop / Test push-button. All the LEDs should light, and the display should contain 8888.

How to Replace Components

Introduction

Return all replaced components to your service center.

The following sections explain how to replace each component. After replacing a component, be sure to:
1. Reconnect all leads exactly as they were removed,
2. Replace any heat-shrink tubing if any old tubing was removed,
3. Retighten all connections
4. Replace covers.

Preparation

Please follow these steps before removing or replacing any component:
Disconnect the battery.
Disconnect the AC power.

MAIN TRANSFORMER

Use the wiring diagrams in the back of this manual to help identify wires connected to the transformer.

Removal

To remove the transformer:
1. Remove the AC input wires from the 3 terminal input blocks.
2. Remove the transformer control voltage wires from the little glass fuse holder.
3. Remove the secondary leads from the SCR/Diode Blocks.
4. In the back compartment of the charger, remove the bolts (as many as 6) that hold the transformer to the charger frame.

WARNING: The transformer is heavy. Use appropriate equipment to lift it.

Replacement

To insert a transformer, follow these instructions:
1. Place the new transformer into the back of the charger, taking care of the transformer's pigtail.
2. Replace the bolts that secure the transformer to the charger frame.
3. Connect the AC input wires onto the 3 terminal input blocks. Do this by pre-bending the wires and trimming the double leads (wires #2 and #5) to the same length. The purpose for doing this is so that when you install the double leads into the terminal block, they both get properly secured when the screw is tightened down on them.

4. Be sure that all wires being connected to the terminal strip are bare. Make sure insulation is removed from the wires for good connections.
5. Avoid placing the A phase primary leads near the top panel's mounting hole.

WARNING:	Be sure to install phase A, phase B, and phase C wires to their proper terminals in the front of the charger (A is on the left, C is on the right).

WARNING:	When installing primary leads into the terminal blocks, take special precaution in preparing the double-wire leads (wires #2 and #5) for insertion into the terminal blocks.

6. Connect the transformer's control voltage wires to the fuses.

WARNING:	Be sure to install 7A, 7B, and 7C in proper order (A is on the left, C is on the right). If they are not connected properly, a phase control problem will occur.

7. Connect the secondary leads to the SCR/Diode Blocks. Again, be careful to connect phase A to phase A, phase B to phase B, etc.

SCR/DIODE BLOCK

Specifications for Mounting SCR/Diode Blocks on Flat Aluminum Heat Sinks:

Surface
1. No scratches, gouges, or burrs allowed in the SCR/Diode Block contact area.
2. No oil, dirt, paint, adhesive or other foreign substances are permitted in the contact area.
3. Apply a light coating of heat sink thermal compound to the flat side of the SCR/Diode Block.

Mounting Instructions
1. Tighten the nut with your fingers as far as possible. Then use the torque wrench. Do not exceed the torques shown in the following table.
2. Do not use any other wrench to tighten the nut.

SCR/Diode Block Size	SCR/Diode Block mounting Torque (in/lb.)		Buss bar mounting Torque (in/lb.)	
	Bolt Size	Max	Bolt Size	Max
104 Amp	10-32 x 1.25	19.0	5mm	31
162 Amp	10-32 x 1.25	19.0	6mm	65
250 Amp	10-32 x 1.25	19.0	8mm	132
285 Amp	10-32 x 1.25	19.0	8mm	132

Removal

The SCR/Diode Blocks cannot be removed until the bussbars are removed first. These steps explain how to remove the heatsink.
1. Remove the DC cable leads.
2. Remove the DC control leads (red) from the PC board.
3. Unplug the SCR/Diode Blocks gate leads.
4. Remove the secondary transformer leads from the input of the SCR/Diode Block.
5. Unscrew the two bussbars from the SCR/Diode Blocks. Note, on the units where the bussbar is directly attached to the jumper wire, leave the bussbar attached to the jumper wire and just move the bussbar away from the SCR/Diode Blocks.
6. Now you can remove the SCR/Diode Block from the heatsink.

Replacement
1. Remove old silicone-heatsink compound from the heatsink.
2. Apply silicone heatsink compound (i.e., thermalloy 249, Aavid 1001, etc.) to the SCR/Diode Block and fasten it to the heatsink. (Use the proper torque. See table above.)
3. Replace the heatsink into the charger case, being careful to slide it onto its holder.
4. Mount the two bussbars back to the SCR/Diode Blocks.
5. Connect the secondary transformer leads to the inputs of the SCR/Diode Blocks.
6. Reconnect the SCR/Diode Block gate leads.
7. Connect the DC control leads to the PC board.
8. Replace the DC cable leads.

Since you have removed the SCR/Diode Block gate leads from the harness, take special care in reconnecting the SCR/Diode Blocks firing lead connections making sure that:

1. Phase A is connected to phase A
2. Phase B to phase B
3. Phase C to phase C.

CONTACTOR (IF AVAILABLE)

Removal

1. Remove the screws holding the contactor in place.
2. Carefully transfer one lead at a time from the old contactor to the replacement contactor.

Replacement

1. Mount the replacement contactor in the charger using the screws from the old contactor.

CONTROL TRANSFORMER (IF AVAILABLE)

Removal

1. Remove the screws holding the control transformer in place.
2. Carefully transfer one lead at a time from the old control transformer to the replacement contactor.

Replacement

1. Mount the replacement control transformer in the charger using the screws from the old control transformer.

PC BOARD

Removal

CAUTION:	Use an anti-static wrist strap (i.e. EnerSys part number 174-2-1) when handling, removing and replacing circuit board assemblies.

Please follow these steps to remove a PC board. (Be sure your hands are clean before touching a PC board).

1. Turn the AC power OFF.
2. Unplug the battery.
3. Touch your finger to a ground to remove any static charge.
4. Unplug the connectors from the PC board.
5. Remove the mounting standoff screws from the PC board.

NOTE: Handle the PC board with care. Do NOT place it on top of the battery or other acid-contaminated surfaces.

6. Place the removed PC board into the anti-static bag (or foam) that the replacement board was in.

Replacement

Please follow these steps to install a PC board.

1. Using the screws from the old PC board, mount the replacement board on the door.
2. Attach the connectors to the replacement board. **Be careful to insert the connectors properly. The connectors should be inserted so that the raised portion of the socket slips under the raised portion of the plug on the PC board.**
3. **NOTE**S FOR D3E2/GTS2 SERIES CHARGERS ONLY:
   a. Verify that the cell size jumpers (JP4) are properly set for this type of charger. The charger nameplate rating shows what the cell size is.
   b. Verify that the shunt element jumpers (JP5) are properly set for this type of charger.
   c. See shunt chart under section Other Replacement Parts.
4. Enter Service Level parameters per the model number of the charger.
5. Perform the four calibration steps to ensure that the correct voltages and currents are being read by the control unit.

EPROM

Please follow these steps before removing or replacing an EPROM:

Disconnect the battery.
Disconnect the AC power.

Removal:

Follow these steps to remove the EPROM. (Be sure your hands are fairly clean before touching a PC board.)

1. Turn the AC power OFF.
2. Unplug the battery.
3. Touch your finger to a ground to discharge static.
4. To remove the EPROM, slip a narrow-bladed screwdriver GENTLY between the socket and the EPROM chip.
5. Carefully pry up the chip, making sure that the legs on both sides of the chip come up at the same time.
6. DO NOT bend the legs.
7. You may need to use a larger screwdriver once the chip is partially out of the socket.
8. Place the removed EPROM into the anti-static bag that the replacement EPROM came in.

Replacement

1. When placing the new EPROM in the socket, make sure that the “notch” on the EPROM and the “notch” on the socket line up.
2. BE CAREFUL when inserting the new EPROM. DO NOT bend the legs. Make sure that the legs go into the proper holes

You may need to change some of the charger’s parameters. The instructions that came with the replacement EPROM will tell you whether it is necessary.

When inserting the new EPROM, DO NOT bend the legs. Verify that the legs go into the proper holes.
Field adjustment and calibrations may be required. Instructions that come with the replacement.
EPROM will specify whether this is necessary.
To replace the PCB, follow the steps outlined in the PCB section.

VOLTAGE CONVERSION

The charger is designed to operate from nominal line voltages as marked on the nameplate. The line voltage to which the charger is to be converted **must be one of the voltages shown on the charger nameplate**.

DANGER: POWER MUST BE DISCONNECTED BEFORE CHANGING AC INPUT CONNECTIONS.

CAUTION: THERE ARE DANGEROUS VOLTAGES WITHIN THE BATTERY CHARGER CABINET.
ONLY QUALIFIED PERSONNEL SHOULD ATTEMPT TO ADJUST OR SERVICE THIS BATTERY CHARGER

AC INPUT CHANGE (STANDARD)

***NOTE**: Chargers with optional Quick Tap™ please refer to* AC Input Change With Quick Tap™.

1. Change AC fuses to the value of the desired line voltage available for this charger. (AC fuse values can be found on the decal inside the charger).

CAUTION: Failure to perform this step may cause the Control Trans. Primary fuse to open.

2. Change provided jumpers, on the main transformer primary tap location, as shown on the decal inside the door of the charger, or on the following charts. (Jumpers not being used are stored in the manual's envelope inside the charger).

3. Indicate the line voltage change on the decal inside the charger.

3PH. WIRING CONN. CHART

WIRING CONNECTION CHART - 3 PHASE SCR CHARGERS
MODEL B

WIRE	208 VOLT INPUT CONNECTION	240 VOLT INPUT CONNECTION	480 VOLT INPUT CONNECTION
D2	F1 to A1	F1 to A1	F1 to A1
D7	F1 to C5	F1 to C6	F1 to C6
D3	F2 to A5	F2 to A6	F2 to A6
D3	F2 to B1	F2 to B1	F2 to B1
D4	F3 to B5	F3 to B6	F3 to B6
D4	F3 to C1	F3 to C1	F3 to C1
A2	A1 to A4	A1 to A4	A3 to A4
A2	A2 to A5	A3 to A6	B3 to B4
A2	B1 to B4	B1 to B4	C3 to C4
A2	B2 to B5	B3 to B6	A3 to A4
A2	C1 to C4	C1 to C4	B3 to B4
A2	C2 to C5	C3 to C6	C3 to C4

WIRING CONNECTION CHART - 3 PHASE SCR CHARGERS
MODEL J

WIRE	480 VOLT INPUT CONNECTION	550 VOLT INPUT CONNECTION	600 VOLT INPUT CONNECTION
D2	F1 to A1	F1 to A1	F1 to A1
D7	F1 to C5	F1 to C6	F1 to C6
D3	F2 to A5	F2 to A6	F2 to A6
D3	F2 to B1	F2 to B1	F2 to B1
D4	F3 to B5	F3 to B6	F3 to B6
D4	F3 to C1	F3 to C1	F3 to C1
A2	A2 to A4*	A2 to A4*	A3 to A4*
A2	B2 to B4*	B2 to B4*	B3 to B4*
A2	C2 to C4*	C2 to C4*	C3 to C4*

*INDICATES TWO JUMPERS

WIRING CONNECTION CHART - 3 PHASE SCR CHARGERS
MODEL D

WIRE	220 VOLT INPUT CONNECTION	380 VOLT INPUT CONNECTION	440 VOLT INPUT CONNECTION
D2	F1 to A1	F1 to A1	F1 to A1
D7	F1 to C6	F1 to C5	F1 to C6
D3	F2 to A6	F2 to A5	F2 to A6
D3	F2 to B1	F2 to B1	F2 to B1
D4	F3 to B6	F3 to B5	F3 to B6
D4	F3 to C1	F3 to C1	F3 to C1
A2	A1 to A4	A2 to A4	A3 to A4
A2	A3 to A6	B2 to B4	B3 to B4
A2	B1 to B4	C2 to C4	C3 to C4
A2	B3 to B6	A2 to A4	A3 to A4
A2	C1 to C4	B2 to B4	B3 to B4
A2	C3 to C6	C2 to C4	C3 to C4

WIRING CONNECTION CHART
3 PHASE SCR CHARGERS
MODEL E

WIRE	400 VOLT INPUT CONNECTION
D2	F1 TO A1
D7	F1 TO C6
D3	F2 TO A6
D3	F2 TO B1
D4	F3 TO B6
D4	F3 TO C1

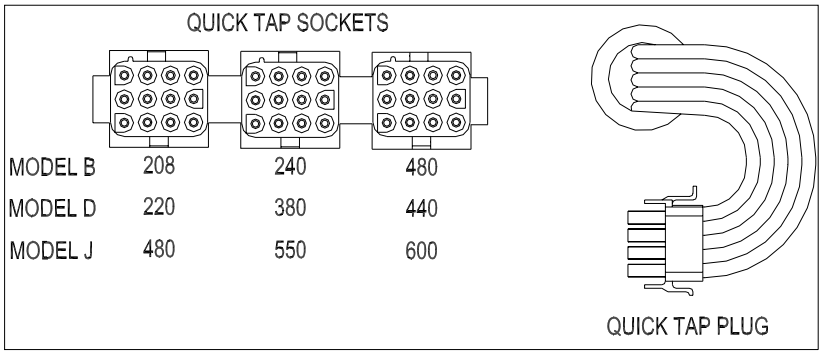
AC INPUT CHANGE WITH QUICK TAP™

If available

CAUTION: CONNECTOR IS KEYED AND PINS ARE FRAGILE.

1. Change AC fuses to the value of the desired line voltage available for this charger. (AC fuse values can be found on the decal inside the charger).
2. Change Quick Tap™ plug to the desired line voltage as marked under the sockets.
3. Indicate the line voltage change on the decal inside the charger.

WIRING CONN. ILLUSTRATION



MAINTENANCE

The charger requires a minimum of maintenance. Connections and terminals should be kept clean and tight. The unit should be periodically cleaned with an air hose to prevent any excessive dirt build up on components. Care should be taken not to bump or move any adjustments during cleaning. Make sure that both the AC lines and the battery are disconnected before cleaning. The frequency of this type of maintenance depends upon the environment in which this unit is installed.

For service, contact your sales representative or call:
1-866-443-9433 (UNITED STATES)
1-800-693-9433 or 905-790-1212 (CANADA)

Or visit us at our website: www.enersysmp.com

REPLACEMENT PARTS

Check the Field Enhancement / Upgrade decal to see if the charger has a TDR # or addendum indicating it was specially built. If this information is not with this manual, contact the factory technical support.

NOTE: When requesting assistance on replacement parts please have the model number, part number, and serial number ready to ensure a fast and accurate service.

COMMON TO ALL SCR STANDARD CHARGERS

Description	Part Number	Ref.*	Description	Part Number	Ref.*
Load Hog charger Door	X054-99-3-3	18	"Fuse Reducer" (less than 70A. fuse into 100A. fuse block)	X014-17-6	N/A
D3G/GTS Charger Door	X054-99-3-2DG	18	"Fuse Reducer" (less than 40A. fuse into 60A. fuse block)	X014-17-5	N/A
D3E2 charger Door	X054-99-3-4	18	Ground Lug	X012-7-24	19
Top Panel Back Panel	X052-99-3-12 X057-99-3-16	4	PC Board Fuses	X014-7-28	12
Side Panel, Left	X057-99-0-5	3			
Side Panel, Right	X057-99-0-6	2	Control Transformer (If available for "B" models)	X127-61-1	N/A
Base	3ph Base kit***	1	Control Transformer (If available for "J" models)	X127-61-4	N/A
Cross Member, Heat Sink	3ph. Base kit***	11	Control Transformer (If available for "D" models)	X127-61-3	N/A
Cross Member, Main Transformers	3ph. Base kit***	6	Contactor 40 Amp (If available)	X129-62-53	N/A
Upright	X052-99-0-6	5	Contactor 60 Amp (If available)	X129-62-54	N/A
Door Latch	X044-1-32	N/A	Wire Group, all SCR chargers , PCB	X1106-99-21	W - 2
Term. Bd., Primary "G" left, Main Transformer	256-99-12	15	Wire Group, Primary voltage, all SCR chargers NOTE: Two sets are required, when the larger AC input is greater than 45A.	X1106-99-23	W - 1
Term. Bd., Primary "H" right, Main Transformer	256-99-13	15	LT2 Chargers wire group Load Hog charger ONLY ID board and additional PCB power); Or	X1106-99-22	N/A
DC cable clamp (for #2, 1/0, 2/0, & 3/0 cable)	356-5-15	20	LTC2 Chargers wire group Load Hog charger with Contactor and Control transformer ONLY (ID board and additional PCB power).	X1106-99-25	N/A
DC cable clamp (for 4/0 cable)	356-5-16	20			
Rivets (Latch)	164-8-6	N/A			

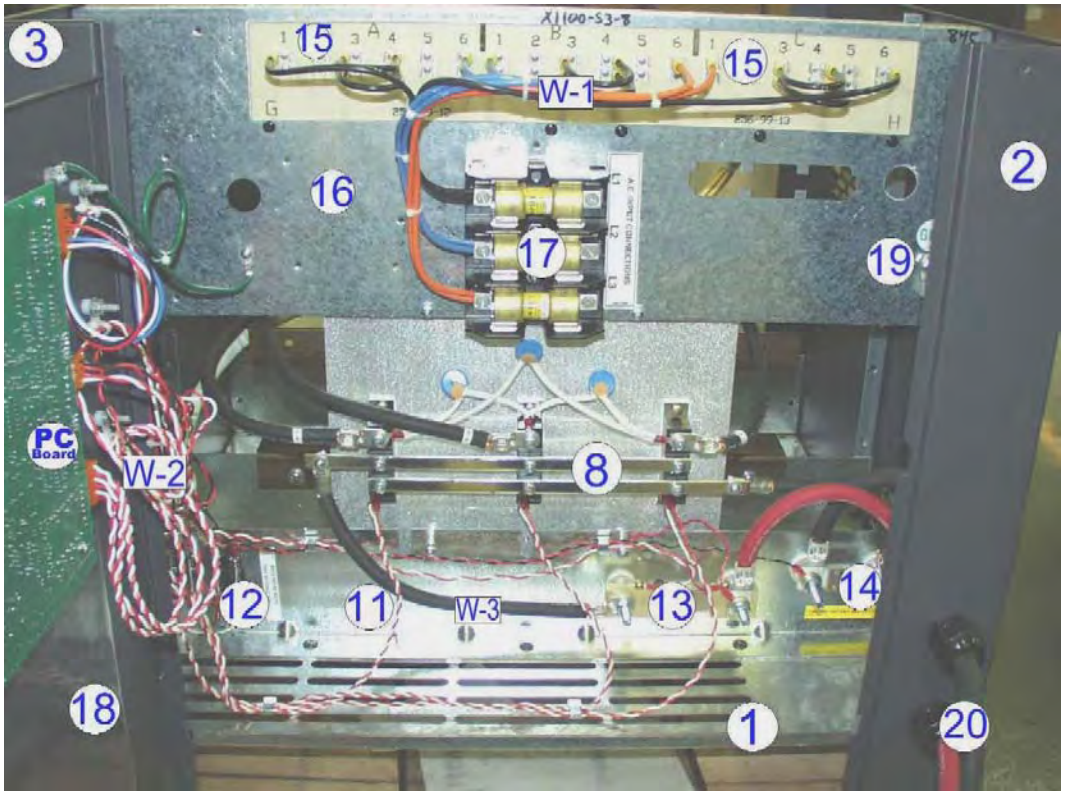
*Refer to item numbers on the following illustrations.

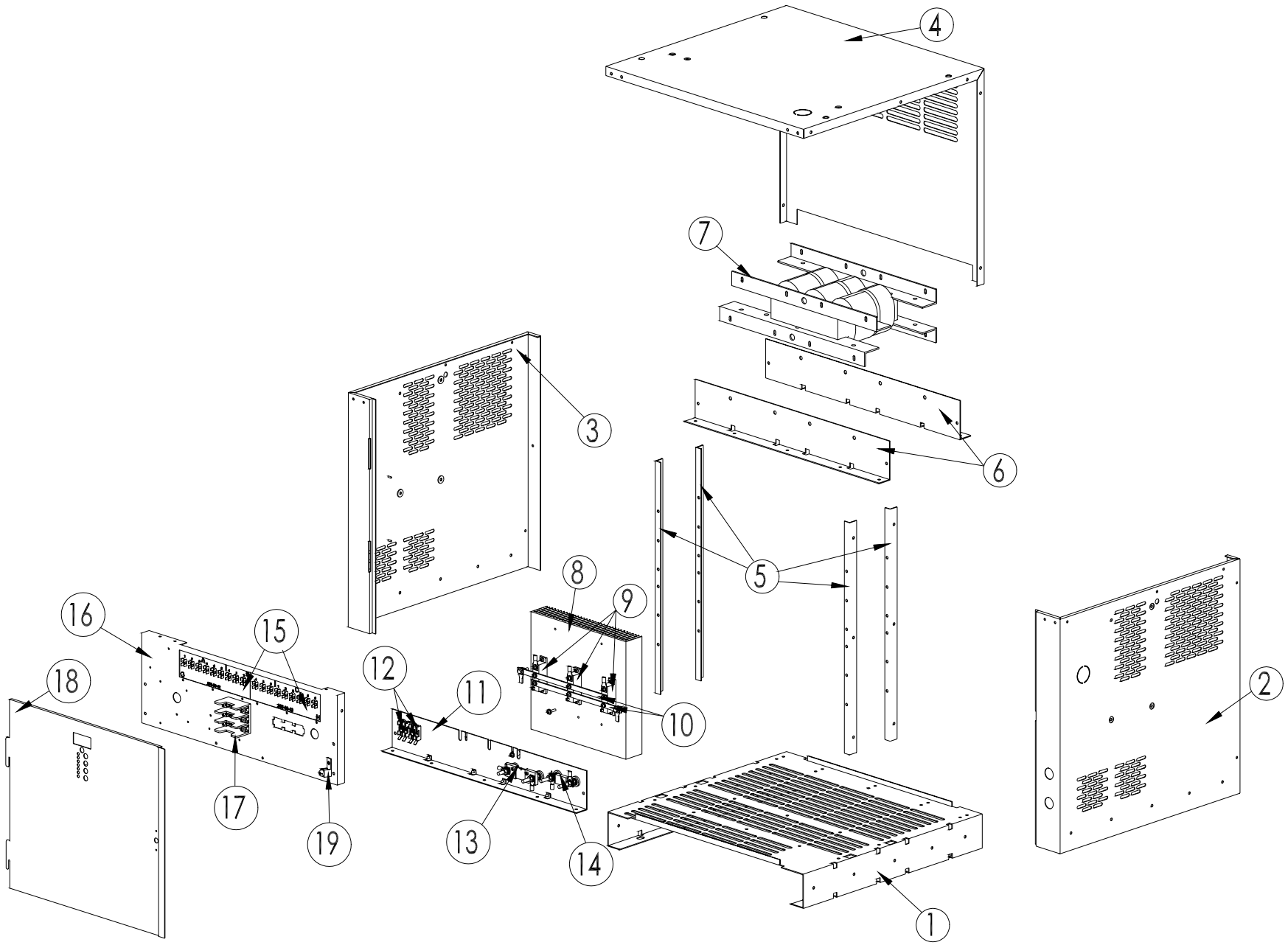
***** Parts require a Base kit: Determine the appropriate kit number for your charger.**
Each kit includes, the base, and cross members for heat sink and transformer.

If, 11-inch distance between transformer brackets	**If, 15-inch distance between transformer brackets, and if there are three (3) heat sink extrusions.**
X225-99-3-11	X225-99-3-15

Note: The illustration below identifies the **location** of some important components in standard chargers. The component P/N may vary from charger to charger. (For a P/N, refer to the 'Replacement Parts' tables).

ITEM #	DESCRIPTION
1	Cabinet, Base
2	Cabinet, Right side
3	Cabinet, Left side
4	Cabinet, Top/Back
5	Upright
6	Cross Member, Main Transformers
7	Main Transformer
8	Heat Sink Assembly
9	SCR/Diode Blocks
10	Bussbar
11	Cross Member, Heat Sink
12	PC Board Fuses, F5, F6, F7, F8
13	Shunt
14	DC Fuse, F4
15	Terminal Board Primary, Main Transformer
15	Terminal Board Primary, Main Transformer
16	Panel, Sub-assembly
17	AC Block / Input Fuses, F1, F2, F3
18	Door
19	Ground Lug
20	DC output cables and clamp
W-1	Wire Group, Primary Voltage
W-2	Wire Group, PC Board
W-3	Cable Connect. Heat Sink & Shunt (See Heat Sink)

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REPLACEMENT PARTS BY CONTROL BOARD

Control Board Fuse (F5 - F8): X014-7-28 (item #12)*

D3G/GTX CONTROL BOARD

X1060-04-D3G-1	STANDARD MODELS

DEPTH/RENEGADE CONTROL BOARD

PC BOARD, (S)D3E2 & (F)GTS2	
X1060-58-1	Standard Models
X1060-58-3	All 54 cell
X1060-58-4	All 40 cell
X1060-58-5	All 60 cell
X1060-58-6	64 cell
X1060-58-99	Standard models with Opportunity charging

DEPTH/RENEGADE DISPLAY BOARD

X1060-58-10

LOAD HOG CONTROL BOARD

<u>Attention</u>: LT2 <u>series</u> chargers have a brand new Load Hog PCB part number. <u>Old control board will not operate LT2</u> charger series.

DESCRIPTION	P/N	MODEL, (S)LT2 & (S)LTC2
PCB	**X1060-60LT-1**	Standard Models
	X1060-60LT-99	Standard model w/ Opportunity charging
	X1060-60LT-3	Discontinued models; 12-680, 18-550

PCB AUXILIARY	X1060-78-1	Only for 36/40-850D

PCB ID	X1060-61-1	(12-680 discontinued model)	X1060-61-6	24-1000
	X1060-61-10	12-850	X1060-61-7	36/40-850/1500
	X1060-61-3	(18-550 discontinued model)	X1060-61-8	24-1600
	X1060-61-4	18-1000	X1060-61-9	24-680
	X1060-61-5	18-1600/2000	X1060-61-11	24-2500

***NOTE**: Control Board replacement requires set up.*

OTHER REPLACEMENT PARTS

HEAT SINK

	Charger(s)	Heat Sink Assy. P/N	Extrusion P/N	SCR/ Diode Blk. P/N	BussBar	Jumpers*	
						Length & P/N	Jumpers Size
Single heat sink Extrusion	450AH to 850AH	R521-99-3-40	*R521-99-3-4*	*R507-18-2 (104A.)*	*090-2-73*	*(6")-124-2B-6 (11")124-2B-11*	*#2*
	950AH to 18-1200AH	R521-99-3-41	*R521-99-3-4*	*R507-18-3 (160A.)*	*090-2-71*	*(6")124-1/0W-26 (11")124-1/0W-11*	*1/0AWG*
Note: One heat sink assembly is required per charger which includes everything: extrusion, SCR/Diode block, bussbars, jumpers, and hardware.							

	Charger(s)	Heat Sink Assy. P/N	Extrusion P/N	SCR/ Diode Blk. P/N	BussBar	Jumpers*	
						Length & P/N	Jumpers Size
Triple Heat sink Extrusion	24-1200AH	R521-99-3-50	*R521-99-3-5*	*R507-18-3 (160A.)*	090-2-75	(6")124-1/0W-26 (11")124-1/0W-11	1/0AWG
	1500AH to 2000AH	R521-99-3-51	*R521-99-3-5*	*R507-18-4 (285A.)*	090-2-74	(6")124-2/0W-6 (11")124-2/0W-14	2/0AWG
Note: Three heat sink assemblies are required per charger and each assembly includes: extrusion, and SCR/Diode block. **Bussbars, jumpers, and hardware shall be ordered separate (See drawings for hardware).**							

* 6-inch jumper connects to DC fuse, and 11-inch jumper connects to Shunt

DC Fuses

Charger(s)	DC fuse values	ANN Fuse P/N	FWA* Fuse P/N
380AH	100 Amp	X014-11-2	N/A
450AH - 680AH	150 Amp	X014-11-3	X014-30-3
750AH - 850AH	200 Amp	X014-11-9	X014-30-5
950AH - 1050AH	250 Amp	X014-11-16	X014-30-4
1200AH	300 Amp	X014-11-17	N/A
1500AH	350 Amp	X014-11-13	N/A
1600AH - 1700AH	400 Amp	X014-11-14	N/A
2000AH	2X250	(2x)X014-11-16	N/A

*NOTE: 36 and 40 cell chargers use "FWA" DC fuse type

SHUNT

Models: D3E2 and GTS2			
Charger(s)	**Shunt P/N**	**Shunt Value**	**JP5 Jumper location**
450AH - 750AH	X117-8-14	150A.	1
850AH - 1050AH	X117-8-15	300A.	2
1200AH - 1700AH	X117-8-16	450A.	3
18-2000AH	(2X)X117-8-15	2-300A.	3

Models: LT2 and LTC2		
Charger(s)	**Shunt P/N**	**Shunt Value**
0 - 850AH	X117-99-2	150A.
1000AH - 1600AH	X117-8-13	300A.

SHUNT MODELS D3G AND GTX		
Ampere-hours	**Value**	**Part Number**
0 - 680	150	X117-99-2
681-1200	300	X117-99-1
1201 & UP	2 X 300	X117-99-1

AC FUSES, MODEL B (208/240/480 V.)

Replacement part numbers for chargers with letter codes "T", "W", "X", and "Y" shall be referred to the charger's tables with code letter "B"

MODEL B	Transformer P/N	AC FUSES								
		208 Volts			240 Volts			480 Volts		
		I AC	Value	P/N	I AC	Value	P/N	I AC	Value	P/N
6-550	X127-S06-550B	7	12	X014-99-12	6	10	X014-99-10	3	5	X014-99-5
6-680	X127-S06-680B	8	12	X014-99-12	7	12	X014-99-12	4	7	X014-99-7
6-750	X127-S06-680B	9	15	X014-99-15	8	12	X014-99-12	4	7	X014-99-7
6-850	X127-S06-850B	10	15	X014-99-15	9	15	X014-99-15	5	8	X014-99-8
6-950	X127-S06-1050B	11	20	X014-99-20	10	15	X014-99-15	5	8	X014-99-8
6-1000	X127-S06-1050B	12	20	X014-99-20	10	15	X014-99-15	5	8	X014-99-8
6-1050	X127-S06-1050B	12	20	X014-99-20	11	20	X014-99-20	6	10	X014-99-10
12-550	X127-S12-550B	13	20	X014-99-20	11	20	X014-99-20	6	10	X014-99-10
12-680	X127-S12-680B	16	25	X014-99-25	14	25	X014-99-25	7	12	X014-99-12
12-750	X127-S12-680B	17	30	X014-99-30	15	25	X014-99-25	8	12	X014-99-12
12-850	X127-S12-850B	20	35	X014-99-35	17	30	X014-99-30	9	15	X014-99-15
12-950	X127-S12-1050B	22	35	X014-99-35	19	30	X014-99-30	10	15	X014-99-15
12-1000	X127-S12-1050B	23	40	X014-99-40	20	35	X014-99-35	10	15	X014-99-15
12-1050	X127-S12-1050B	24	40	X014-99-40	21	35	X014-99-35	11	20	X014-99-20
12-1200	X127-S12-1200B	28	45	X014-99-45	24	40	X014-99-40	12	20	X014-99-20
18-550	X127-S18-550B	19	30	X014-99-30	17	30	X014-99-30	9	15	X014-99-15
18-680	X127-S18-680B	24	40	X014-99-40	20	35	X014-99-35	10	15	X014-99-15
18-750	X127-S18-680B	26	40	X014-99-40	22	35	X014-99-35	11	20	X014-99-20
18-850	X127-S18-850B	29	45	X014-99-45	25	40	X014-99-40	13	20	X014-99-20
18-950	X127-S18-1050B	33	50	X014-99-50	28	45	X014-99-45	14	25	X014-99-25
18-1000	X127-S18-1050B	34	50	X014-99-50	30	50	X014-99-50	15	25	X014-99-25
18-1050	X127-S18-1050B	36	60	X014-99-60	31	50	X014-99-50	16	25	X014-99-25
18-1200	X127-S18-1200B	41	60	X014-99-60	36	60	X014-99-60	18	30	X014-99-30
18-1500	X127-S18-1500B	51	80	X014-99-80	44	70	X014-99-70	22	35	X014-99-35
18-1600	X127-S18-1700B	55	80	X014-99-80	47	70	X014-99-70	24	40	X014-99-40
18-1700	X127-S18-1700B	58	90	X014-99-90	50	80	X014-99-80	25	40	X014-99-40
18-2000	X127-S18-2000B	68	100	X014-99-100	59	90	X014-99-90	30	50	X014-99-50
24-550	X127-S24-550B	25	40	X014-99-40	22	35	X014-99-35	11	20	X014-99-20
24-680	X127-S24-680B	31	50	X014-99-50	27	45	X014-99-45	14	25	X014-99-25
24-750	X127-S24-680B	34	50	X014-99-50	30	50	X014-99-50	15	25	X014-99-25
24-850	X127-S24-850B	39	60	X014-99-60	34	50	X014-99-50	17	30	X014-99-30
24-950	X127-S24-1050B	43	70	X014-99-70	38	60	X014-99-60	19	35	X014-99-35
24-1000	X127-S24-1050B	46	70	X014-99-70	40	60	X014-99-60	20	35	X014-99-35
24-1050	X127-S24-1050B	48	70	X014-99-70	42	60	X014-99-60	21	35	X014-99-35
24-1200	X127-S24-1200B	55	80	X014-99-80	47	70	X014-99-70	24	40	X014-99-40
24-1500	X127-S24-1500B	68	100	X014-99-100	59	90	X014-99-90	30	50	X014-99-50
24-1600	X127-S24-1500B	73	100	X014-99-100	63	100	X014-99-100	32	50	X014-99-50
36-450	X127-S40-550B	31	50	X014-99-50	27	45	X014-99-45	14	25	X014-99-25
36-550	X127-S40-550B	38	60	X014-99-60	33	50	X014-99-50	17	30	X014-99-30
36-680	X127-S40-680B	47	70	X014-99-70	40	60	X014-99-60	20	35	X014-99-35
36-750	X127-S40-750B	51	80	X014-99-80	44	70	X014-99-70	22	35	X014-99-35
36-850	X127-S40-850B	58	90	X014-99-90	50	80	X014-99-80	25	40	X014-99-40
36-1000	X127-S36-1050B	68	100	X014-99-100	59	90	X014-99-90	30	50	X014-99-50
36-1050	X127-S36-1050B	72	100	X014-99-100	62	90	X014-99-90	31	50	X014-99-50
40-450	X127-S40-550B	34	50	X014-99-50	30	50	X014-99-50	15	25	X014-99-25
40-550	X127-S40-550B	42	60	X014-99-60	36	60	X014-99-60	18	30	X014-99-30
40-680	X127-S40-680B	52	80	X014-99-80	45	70	X014-99-70	23	40	X014-99-40
40-750	X127-S40-680B	57	90	X014-99-90	49	70	X014-99-70	25	40	X014-99-40
40-850	X127-S40-850B	64	100	X014-99-100	56	90	X014-99-90	28	45	X014-99-45
40-1000	X127-S40-1050B	76	N/A	N/A	66	100	X014-99-100	33	50	X014-99-50
40-1050	X127-S40-1050B	79	N/A	N/A	69	100	X014-99-100	35	50	X014-99-50

AC FUSES, MODEL D (220/380/440 V.)

MODEL D	Transformer P/N	AC FUSES								
		220 Volts			380 Volts			440 Volts		
		I AC	Value	P/N	I AC	Value	P/N	I AC	Value	P/N
6-550	X127-S06-550D	6	10	X014-99-10	4	7	X014-99-7	3	5	X014-99-5
6-680	X127-S06-680D	8	12	X014-99-12	5	8	X014-99-8	4	7	X014-99-7
6-750	X127-S06-680D	8	12	X014-99-12	5	8	X014-99-8	4	7	X014-99-7
6-850	X127-S06-850D	10	15	X014-99-15	6	10	X014-99-10	5	8	X014-99-8
6-950	X127-S06-1050D	11	20	X014-99-20	6	10	X014-99-10	6	10	X014-99-10
6-1000	X127-S06-1050D	11	20	X014-99-20	7	12	X014-99-12	6	10	X014-99-10
6-1050	X127-S06-1050D	12	20	X014-99-20	7	12	X014-99-12	6	10	X014-99-10
12-550	X127-S12-550D	12	20	X014-99-20	7	12	X014-99-12	6	10	X014-99-10
12-680	X127-S12-680D	15	25	X014-99-25	9	15	X014-99-15	8	12	X014-99-12
12-750	X127-S12-680D	16	25	X014-99-25	10	15	X014-99-15	8	12	X014-99-12
12-850	X127-S12-850D	19	30	X014-99-30	11	20	X014-99-20	10	15	X014-99-15
12-950	X127-S12-1050D	21	35	X014-99-35	12	20	X014-99-20	11	20	X014-99-20
12-1000	X127-S12-1050D	22	35	X014-99-35	13	20	X014-99-20	11	20	X014-99-20
12-1050	X127-S12-1050D	23	40	X014-99-40	13	20	X014-99-20	12	20	X014-99-20
12-1200	X127-S12-1200D	26	40	X014-99-40	15	25	X014-99-25	13	20	X014-99-20
18-550	X127-S18-550D	18	30	X014-99-30	11	20	X014-99-20	9	15	X014-99-15
18-680	X127-S18-680D	22	35	X014-99-35	13	20	X014-99-20	11	20	X014-99-20
18-750	X127-S18-680D	24	40	X014-99-40	14	25	X014-99-25	12	20	X014-99-20
18-850	X127-S18-850D	28	45	X014-99-45	16	25	X014-99-25	14	25	X014-99-25
18-950	X127-S18-1050D	31	50	X014-99-50	18	30	X014-99-30	16	25	X014-99-25
18-1000	X127-S18-1050D	32	50	X014-99-50	19	30	X014-99-30	16	25	X014-99-25
18-1050	X127-S18-1050D	34	50	X014-99-50	20	35	X014-99-35	17	30	X014-99-30
18-1200	X127-S18-1200D	39	60	X014-99-60	23	40	X014-99-40	20	35	X014-99-35
18-1500	X127-S18-1500D	48	70	X014-99-70	28	45	X014-99-45	24	40	X014-99-40
18-1600	X127-S18-1700D	52	80	X014-99-80	30	50	X014-99-50	26	40	X014-99-40
18-1700	X127-S18-1700D	55	80	X014-99-80	32	50	X014-99-50	28	45	X014-99-45
18-2000	X127-S18-2000D	64	100	X014-99-100	38	60	X014-99-60	32	50	X014-99-50
24-550	X127-S24-550D	24	40	X014-99-40	14	25	X014-99-25	12	20	X014-99-20
24-680	X127-S24-680D	30	50	X014-99-50	17	30	X014-99-30	15	25	X014-99-25
24-750	X127-S24-680D	32	50	X014-99-50	19	30	X014-99-30	16	25	X014-99-25
24-850	X127-S24-850D	37	60	X014-99-60	21	35	X014-99-35	19	30	X014-99-30
24-950	X127-S24-1050D	41	60	X014-99-60	24	40	X014-99-40	21	35	X014-99-35
24-1000	X127-S24-1050D	43	70	X014-99-70	25	40	X014-99-40	22	35	X014-99-35
24-1050	X127-S24-1050D	45	70	X014-99-70	26	40	X014-99-40	23	40	X014-99-40
24-1200	X127-S24-1200D	52	80	X014-99-80	30	50	X014-99-50	26	40	X014-99-40
24-1500	X127-S24-1500D	64	100	X014-99-100	38	60	X014-99-60	32	50	X014-99-50
36-450	X127-S40-550D	29	45	X014-99-45	17	30	X014-99-30	15	25	X014-99-25
36-550	X127-S40-550D	36	60	X014-99-60	21	35	X014-99-35	18	30	X014-99-30
36-680	X127-S40-680D	44	70	X014-99-70	26	40	X014-99-40	22	35	X014-99-35
36-750	X127-S36-680D	48	70	X014-99-70	28	45	X014-99-45	24	40	X014-99-40
36-850	X127-S40-850D	55	80	X014-99-80	32	50	X014-99-50	28	45	X014-99-45
36-1000	X127-S40-1050D	64	100	X014-99-100	38	60	X014-99-60	32	50	X014-99-50
36-1050	X127-S40-1050D	68	100	X014-99-100	39	60	X014-99-60	34	50	X014-99-50
40-450	X127-S40-550D	32	50	X014-99-50	19	30	X014-99-30	16	25	X014-99-25
40-550	X127-S40-550D	40	60	X014-99-60	23	40	X014-99-40	20	35	X014-99-35
40-680	X127-S40-680D	49	70	X014-99-70	28	45	X014-99-45	25	40	X014-99-40
40-750	X127-S40-680D	54	80	X014-99-80	31	50	X014-99-50	27	45	X014-99-45
40-850	X127-S40-850D	61	90	X014-99-90	35	50	X014-99-50	31	50	X014-99-50
40-1000	X127-S40-1050D	72	N/A	N/A	42	60	X014-99-60	36	60	X014-99-60
40-1050	X127-S40-1050D	75	N/A	N/A	44	70	X014-99-70	38	60	X014-99-60

AC FUSES, MODEL J (480/550/600 V.)

MODEL J	Transformer P/N	AC FUSES								
		480 Volts			550 Volts			600 Volts		
		I AC	Value	P/N	I AC	Value	P/N	I AC	Value	P/N
6-550	X127-S06-550J	3	5	X014-99-5	3	5	X014-99-5	3	5	X014-99-5
6-680	X127-S06-680J	4	7	X014-99-7	3	5	X014-99-5	3	5	X014-99-5
6-750	X127-S06-680J	4	7	X014-99-7	4	7	X014-99-7	3	5	X014-99-5
6-850	X127-S06-850J	5	8	X014-99-8	4	7	X014-99-7	4	7	X014-99-7
6-950	X127-S06-1050J	5	8	X014-99-8	5	8	X014-99-8	4	7	X014-99-7
6-1000	X127-S06-1050J	5	8	X014-99-8	5	8	X014-99-8	4	7	X014-99-7
6-1050	X127-S06-1050J	6	10	X014-99-10	5	8	X014-99-8	5	8	X014-99-8
12-550	X127-S12-550J	6	10	X014-99-10	5	8	X014-99-8	5	8	X014-99-8
12-680	X127-S12-680J	7	12	X014-99-12	6	10	X014-99-10	6	10	X014-99-10
12-750	X127-S12-680J	8	12	X014-99-12	7	12	X014-99-12	6	10	X014-99-10
12-850	X127-S12-680J	9	15	X014-99-15	8	12	X014-99-12	7	12	X014-99-12
12-950	X127-S12-1050J	10	15	X014-99-15	9	15	X014-99-15	8	12	X014-99-12
12-1000	X127-S12-1050J	10	15	X014-99-15	9	15	X014-99-15	8	12	X014-99-12
12-1050	X127-S12-1050J	11	20	X014-99-20	9	15	X014-99-15	9	15	X014-99-15
12-1200	X127-S12-1200J	12	20	X014-99-20	11	20	X014-99-20	10	15	X014-99-15
18-550	X127-S18-550J	9	15	X014-99-15	8	12	X014-99-12	7	12	X014-99-12
18-680	X127-S18-680J	10	15	X014-99-15	9	15	X014-99-15	8	12	X014-99-12
18-750	X127-S18-680J	11	20	X014-99-20	10	15	X014-99-15	9	15	X014-99-15
18-850	X127-S18-850J	13	20	X014-99-20	11	20	X014-99-20	10	15	X014-99-15
18-950	X127-S18-1050J	14	25	X014-99-25	13	20	X014-99-20	12	20	X014-99-20
18-1000	X127-S18-1050J	15	25	X014-99-25	13	20	X014-99-20	12	20	X014-99-20
18-1050	X127-S18-1050J	16	25	X014-99-25	14	25	X014-99-25	13	20	X014-99-20
18-1200	X127-S18-1200J	18	30	X014-99-30	16	25	X014-99-25	15	25	X014-99-25
18-1500	X127-S18-1500J	22	40	X014-99-40	20	40	X014-99-40	18	35	X014-99-35
18-1600	X127-S18-1700J	24	40	X014-99-40	21	40	X014-99-40	19	35	X014-99-35
18-1700	X127-S18-1700J	25	40	X014-99-40	22	40	X014-99-40	20	35	X014-99-35
18-2000	X127-S18-2000J	30	50	X014-99-50	26	40	X014-99-40	24	40	X014-99-40
24-550	X127-S24-681J	11	20	X014-99-20	10	15	X014-99-15	9	15	X014-99-15
24-680	X127-S24-681J	14	25	X014-99-25	12	20	X014-99-20	11	20	X014-99-20
24-750	X127-S24-681J	15	25	X014-99-25	13	20	X014-99-20	12	20	X014-99-20
24-850	X127-S24-850J	17	30	X014-99-30	15	25	X014-99-25	14	25	X014-99-25
24-950	X127-S24-1050J	19	30	X014-99-30	17	30	X014-99-30	15	25	X014-99-25
24-1000	X127-S24-1050J	20	35	X014-99-35	18	30	X014-99-30	16	25	X014-99-25
24-1050	X127-S24-1050J	21	35	X014-99-35	18	30	X014-99-30	17	30	X014-99-30
24-1200	X127-S24-1200J	24	40	X014-99-40	21	35	X014-99-35	19	30	X014-99-30
24-1500	X127-S24-1500J	30	50	X014-99-50	26	40	X014-99-40	24	40	X014-99-40
36-450	X127-S40-550J	14	25	X014-99-25	12	20	X014-99-20	11	20	X014-99-20
36-550	X127-S40-550J	17	30	X014-99-30	15	25	X014-99-25	13	20	X014-99-20
36-680	X127-S40-680J	20	35	X014-99-35	18	30	X014-99-30	16	25	X014-99-25
36-750	X127-S36-680J	22	35	X014-99-35	20	35	X014-99-35	18	30	X014-99-30
36-850	X127-S40-850J	25	40	X014-99-40	22	35	X014-99-35	20	35	X014-99-35
36-1000	X127-S40-1050J	30	50	X014-99-50	26	40	X014-99-40	24	40	X014-99-40
36-1050	X127-S40-1050J	31	50	X014-99-50	27	45	X014-99-45	25	40	X014-99-40
40-450	X127-S40-550J	15	25	X014-99-25	13	20	X014-99-20	12	20	X014-99-20
40-550	X127-S40-550J	18	30	X014-99-30	16	25	X014-99-25	15	25	X014-99-25
40-680	X127-S40-680J	23	40	X014-99-40	20	35	X014-99-35	18	30	X014-99-30
40-750	X127-S40-680J	25	40	X014-99-40	22	35	X014-99-35	20	35	X014-99-35
40-850	X127-S40-850J	28	45	X014-99-45	25	40	X014-99-40	23	40	X014-99-40
40-1000	X127-S40-1050J	33	50	X014-99-50	29	45	X014-99-45	27	45	X014-99-45
40-1050	X127-S40-1050J	35	50	X014-99-50	30	50	X014-99-50	28	45	X014-99-45

SPECIAL MODELS

NOTE: special charger models might not be listed in these tables. However, AC input is listed on the charger's nameplate.

AC fuse-values are listed on a decal inside the charger. The AC fuse part number would be: X014-99-X

X=AC fuse value

Replacement Charger Cables

Charger Cable Size

Charger AH. Rating	Standard Cable Ga.
0 - 775	#2
776 - 1050	1/0
1051 - 1200	2/0
1201 - 1500	3/0
1501 - 1700	4/0

Replacement kits

CABLE GAUGE	KIT FOR SB 175 CONNECTOR	KIT FOR SB 350 CONNECTOR
#2	X225-#2-175	X225-#2-350
1/0	X225-1/0-175	X225-1/0-350
2/0	N/A	X225-2/0-350
3/0	N/A	X225-3/0-350

Cable kits above are nine feet (9') long. For longer cable two more lengths are available: twenty feet (20'), and thirty feet (30'). Example part numbers: **X225-2/0-350-20** for twenty feet of cable; or **X225-2/0-350-30** for thirty feet of cable.

NOTE: Cable kits do not include the connector housing, only the contact. Select desired connector housing below.

Connector Housing Part Numbers

CONNECTOR PART NUMBER	DESCRIPTION	Cable Size	CONNECTOR PART NUMBER	DESCRIPTION	Cable Size
05804	EC CHR HALF	#2 - 2/0	06340	SBX350 GRAY	#2 - 4/0
06316	SB175 3 POLE	#2 - 1/0	06341	SBX350 BLUE	#2 - 4/0
06320	SB350 GRAY	#2 - 4/0	06342	SBX350 RED	#2 - 4/0
06321	SB350 BLUE	#2 - 4/0	06343	SBX350 GREEN	#2 - 4/0
06322	SB350 RED	#2 - 4/0	06359	SBX350 BLACK	#2 - 4/0
06323	SB350 YELLOW	#2 - 4/0	06360	SBX350 YELLOW	#2 - 4/0
06324	SB350 GREEN	#2 - 4/0	06370	SBX175 GRAY	#2 - 1/0
06325	SB175 GRAY	#2 - 1/0	06371	SBX175 BLUE	#2 - 1/0
06326	SB175 BLUE	#2 - 1/0	06372	SBX175 ORANGE	#2 - 1/0
06327	SB175 ORANGE	#2 - 1/0	06373	SBX175 YELLOW	#2 - 1/0
06328	SB175 YELLOW	#2 - 1/0	06378	SBX175 RED	#2 - 1/0
06329	SB175 RED	#2 - 1/0	07205	YC RECEPTACLE	#2 - 3/0
06400	SB350 ORANGE	#2 - 4/0	06368	SBX350 ORANGE	#2 - 4/0

When ordering replacement cables:

1. Determine cable size and length (9', 20', or 30').
2. Determine kit part number by connector type (SB175 or SB350).
3. Determine connector housing part number.

Example: A charger requiring **twenty feet (20')** of **2/0AWG Ga**. cables and a **SB350 RED** connector; the part numbers to order are:

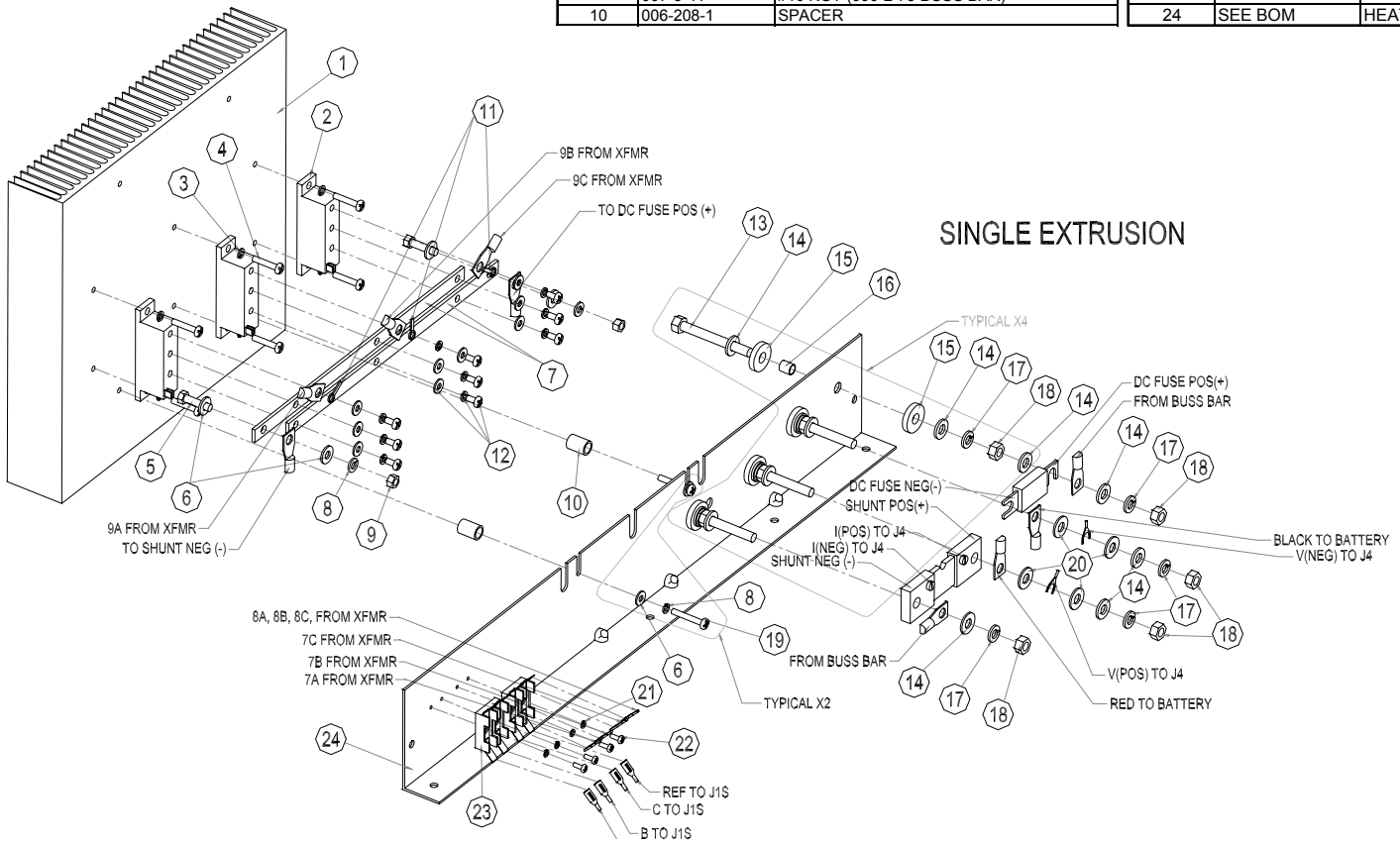
1. **X225-2/0-350-20**
2. **6322**

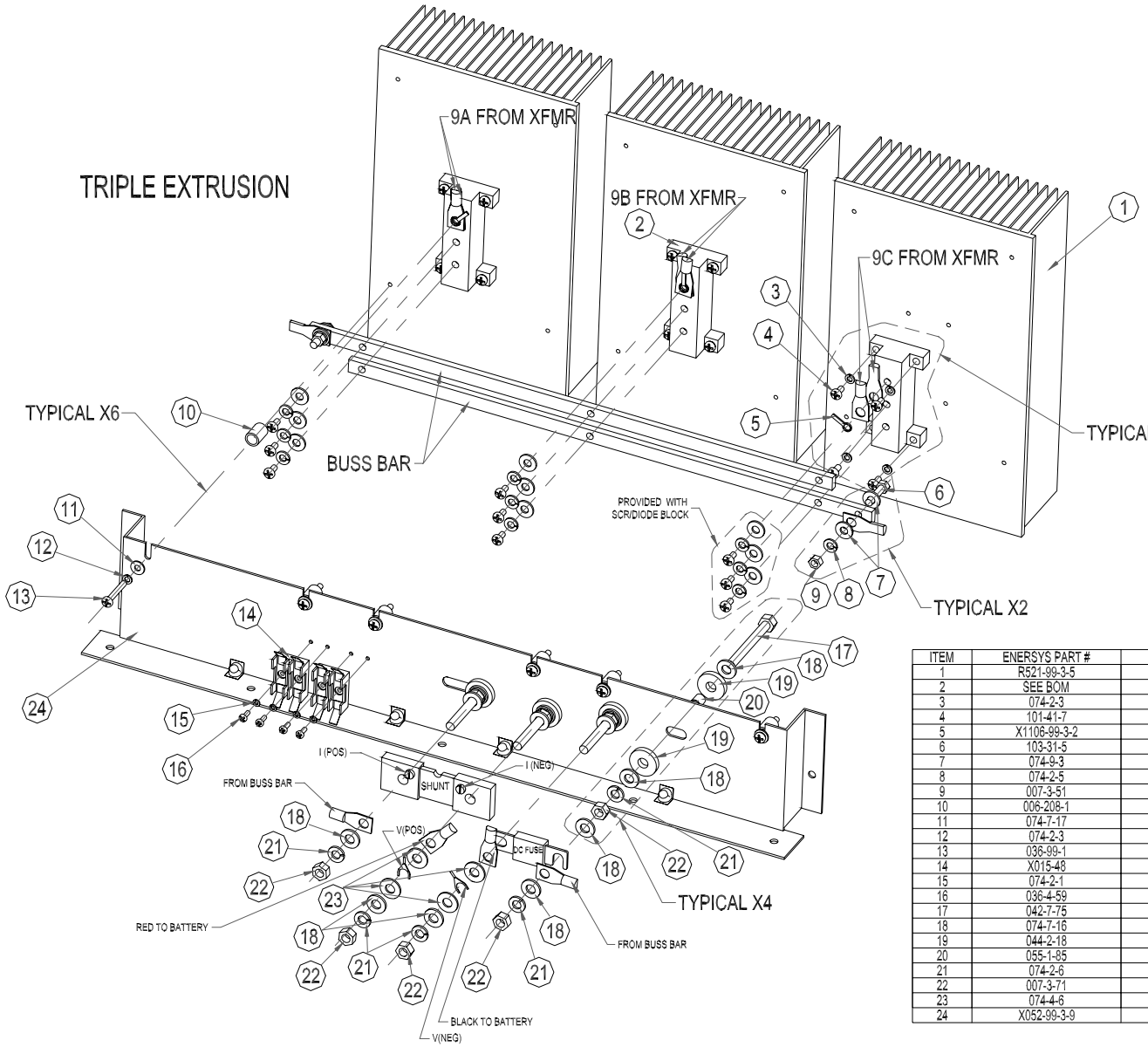
Drawings and schematics

HEAT SINKS

ITEM	PART NUMBER	DESCRIPTION
1	R521-99-3-4	HEAT SINK EXTRUSION
2	SEE BOM	SCR/DIODE BLOCK
3	074-2-3	#10 LOCK WASHER
4	101-41-7	#10 SCREW
5	103-32-5	1/4 SCREW (090-2-71 BUSS BAR)
	103-21-10	#10 SCREW (090-2-73 BUSS BAR)
6	074-9-3	1/4 FLAT WASHER (090-2-71 BUSS BAR)
	074-7-17	#10 FLAT WASHER (090-2-73 BUSS BAR)
7	090-2-71	BUSS BAR (SEE BOM)
	090-2-73	BUSS BAR (SEE BOM)
8	074-2-5	1/4 LOCK WASHER (090-2-71 BUSS BAR)
	074-2-3	#10 LOCK WASHER (090-2-73 BUSS BAR)
9	007-3-51	1/4 NUT (090-2-71 BUSS BAR)
	007-3-41	#10 NUT (090-2-73 BUSS BAR)
10	006-208-1	SPACER

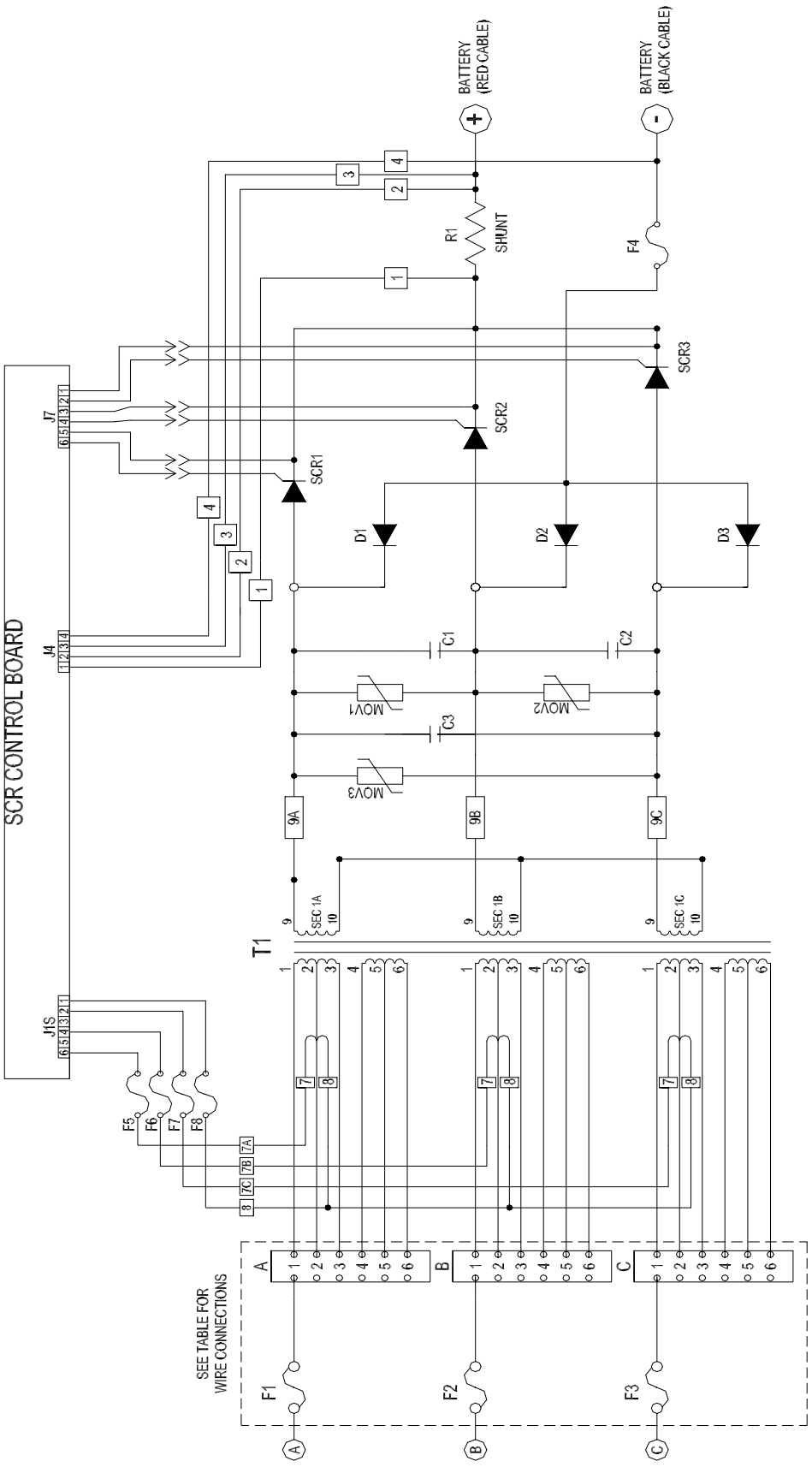
ITEM	PART NUMBER	DESCRIPTION
11	X1106-99-3-1	SUPPRESSOR ASSEMBLY
12	PROVIDED	FLAT WASHER, LOCK WASHER, NUT
13	042-7-75	5/16 X 2.75" BOLT
14	074-7-16	5/16 FLAT WASHER
15	044-2-18	INSULATION WASHER
16	055-1-85	INSULATION BUSHING
17	074-2-6	5/16 LOCK WASHER
18	007-3-71	5/16 NUT
19	036-99-1	#10 X 1.25" SCREW
20	074-4-6	5/16 FLAT WASHER, BRASS
21	074-2-1	#6 LOCK WASHER
22	036-4-59	#6 SCREW
23	X015-48	FUSE BLOCK
24	SEE BOM	HEAT SINK MOUNTING PANEL



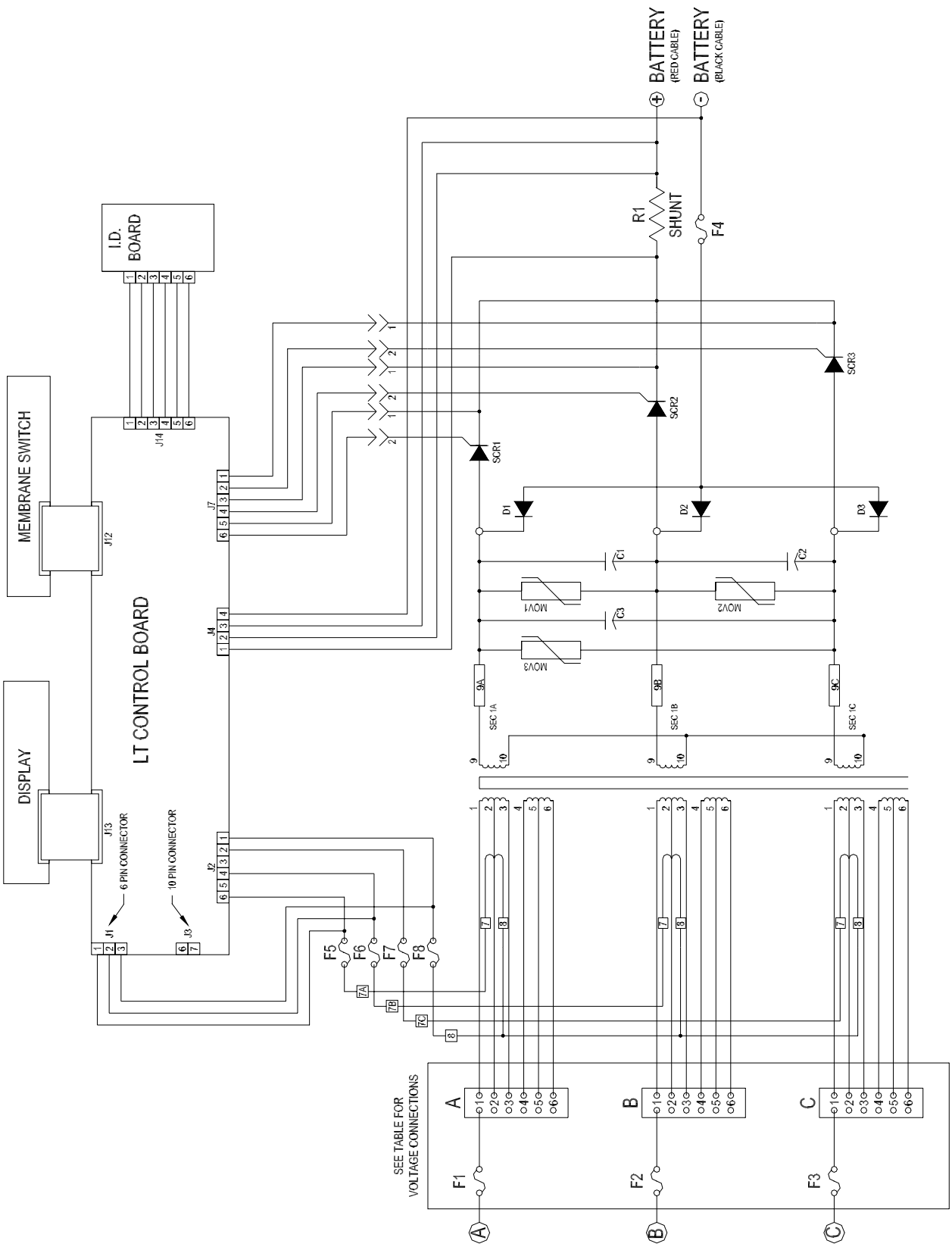


ITEM	ENERSYS PART #	DESCRIPTION
1	R521-99-3-5	HEAT SINK EXTRUSION
2	SEE BOM	SCR/DIODE BLOCK
3	074-2-3	#10 LOCK WASHER
4	101-41-7	#10-3/4" SCREW
5	X1106-99-3-2	SUPPRESSOR ASS'Y
6	103-31-5	1/4" SCREW
7	074-9-3	1/4" FLAT WASHER
8	074-2-5	1/4" LOCK WASHER
9	007-3-51	1/4" NUT
10	006-208-1	SPACER
11	074-7-17	#10 FLAT WASHER
12	074-2-3	#10 LOCK WASHER
13	036-99-1	#10 X 1.25" SCREW
14	X015-48	FUSE BLOCK
15	074-2-1	#6 LOCK WASHER
16	036-4-59	#6 SCREW
17	042-7-75	5/16 -18 X 2.75" BOLT
18	074-7-16	5/16 FLAT WASHER
19	044-2-18	INSULATION WASHER
20	055-1-85	INSULATION BUSHING
21	074-2-6	5/16 LOCK WASHER
22	007-3-71	5/16 NUT
23	074-4-6	5/16 FLAT WASHER, BRASS
24	X052-99-3-9	HEAT SINK MTG PANEL

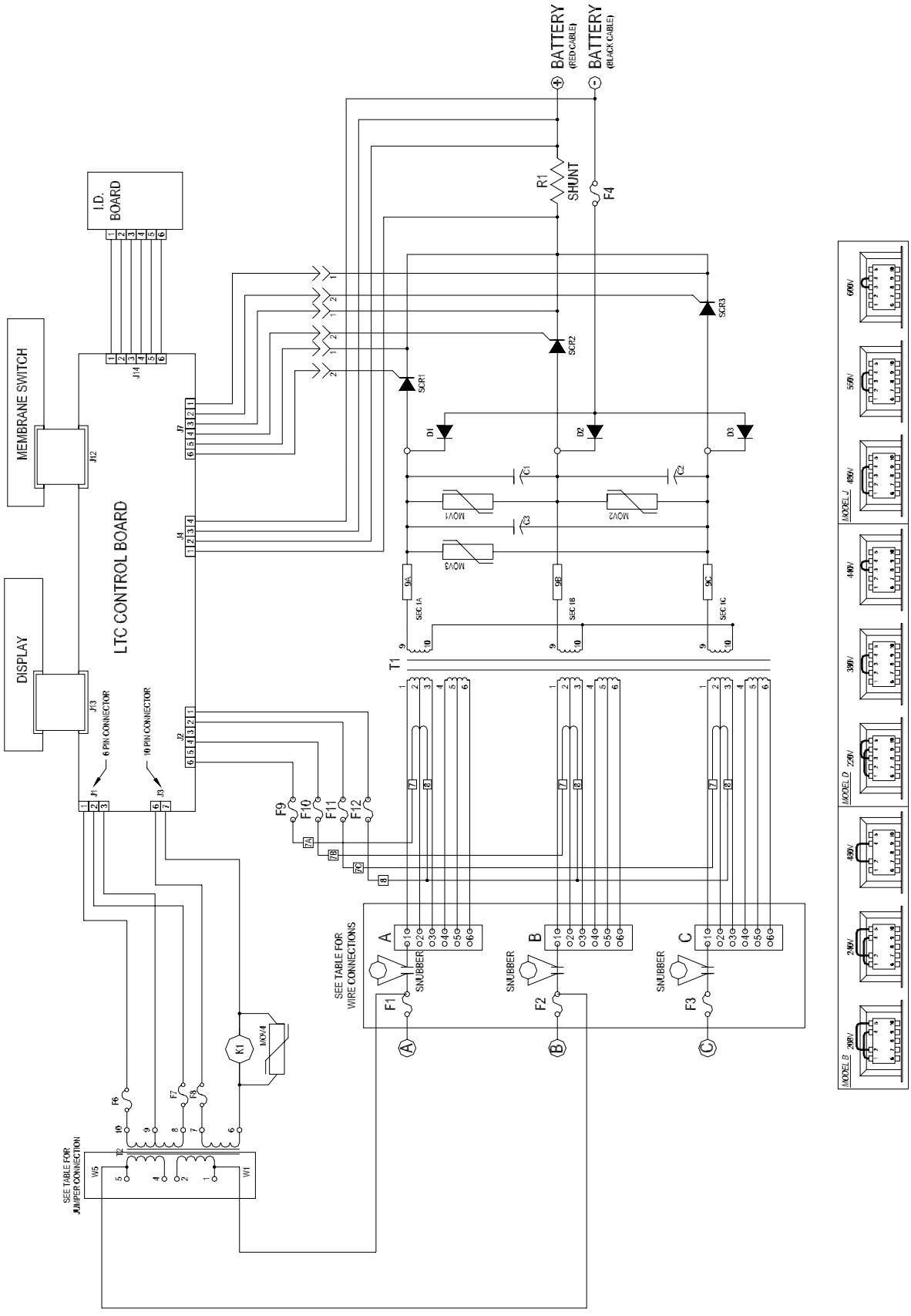
Schematics


SCR CONTROL BOARD
J7
J4
J1S
BATTERY (RED CABLE)
BATTERY (BLACK CABLE)
R1
SHUNT
F4
SCR1
SCR2
SCR3
D1
D2
D3
C1
C2
C3
MOV1
MOV2
MOV3
9A
9B
9C
T1
SEC 1A
SEC 1B
SEC 1C
F5
F6
F7
F8
F1
F2
F3
A
B
C
SEE TABLE FOR WIRE CONNECTIONS

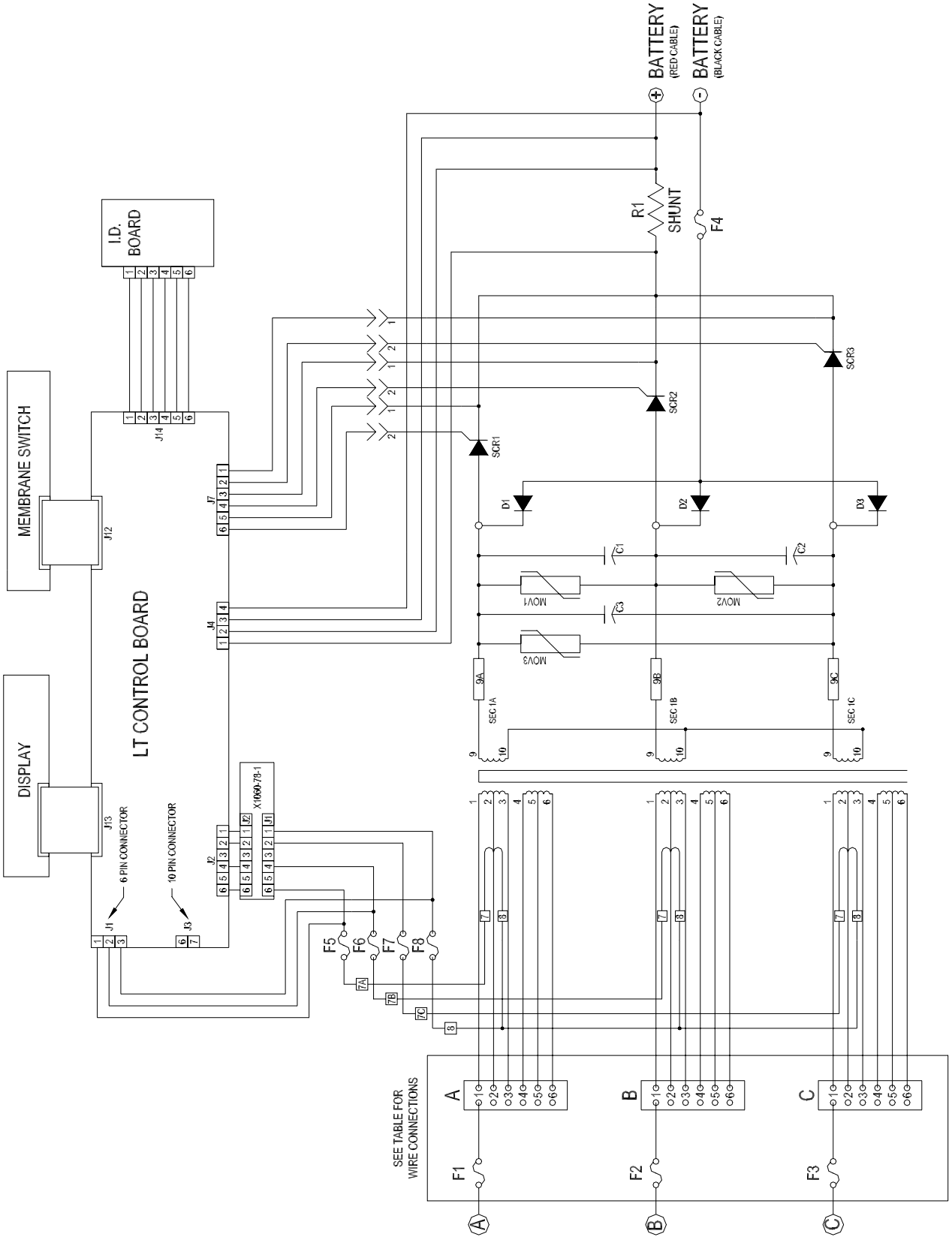
SCHEMATIC LT2



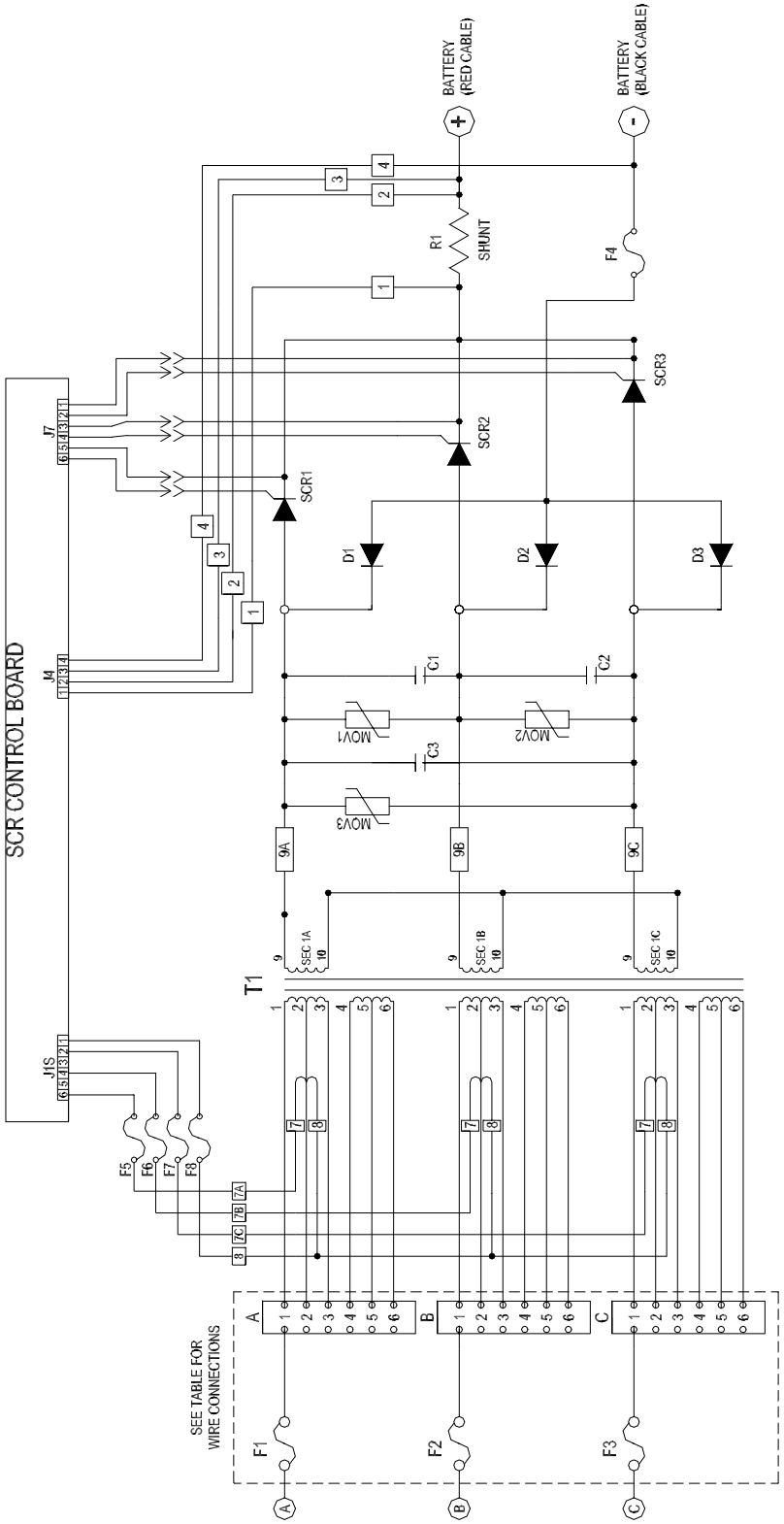
SCHEMATIC LTC2



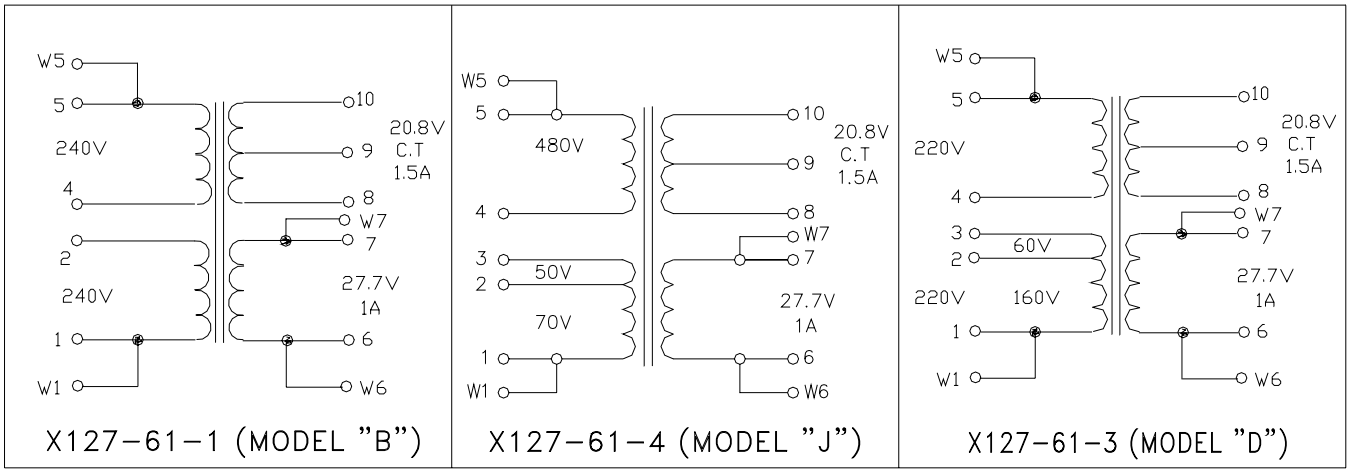
SCHEMATIC, LT2-18-850D



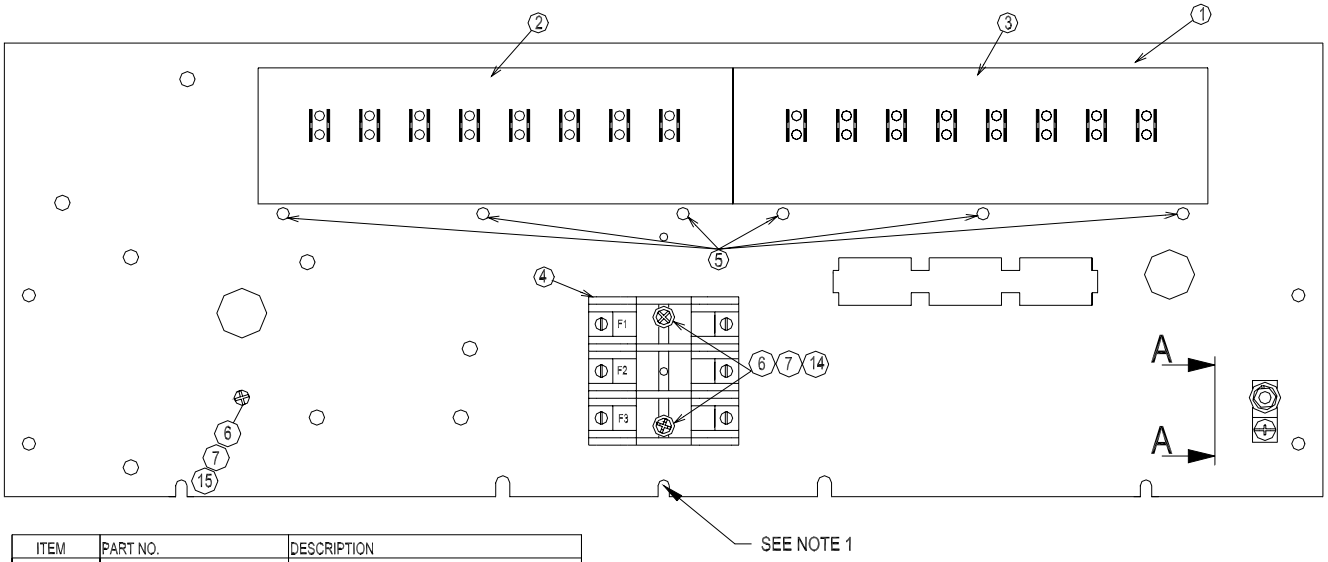
SCHEMATIC, D3G / GTX



CONTROL TRANSFORMERS

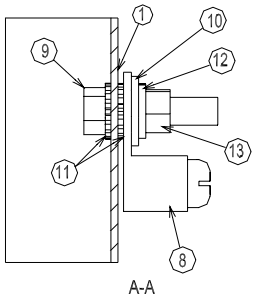


SUB-ASSEMBLY PANEL AND WIRING



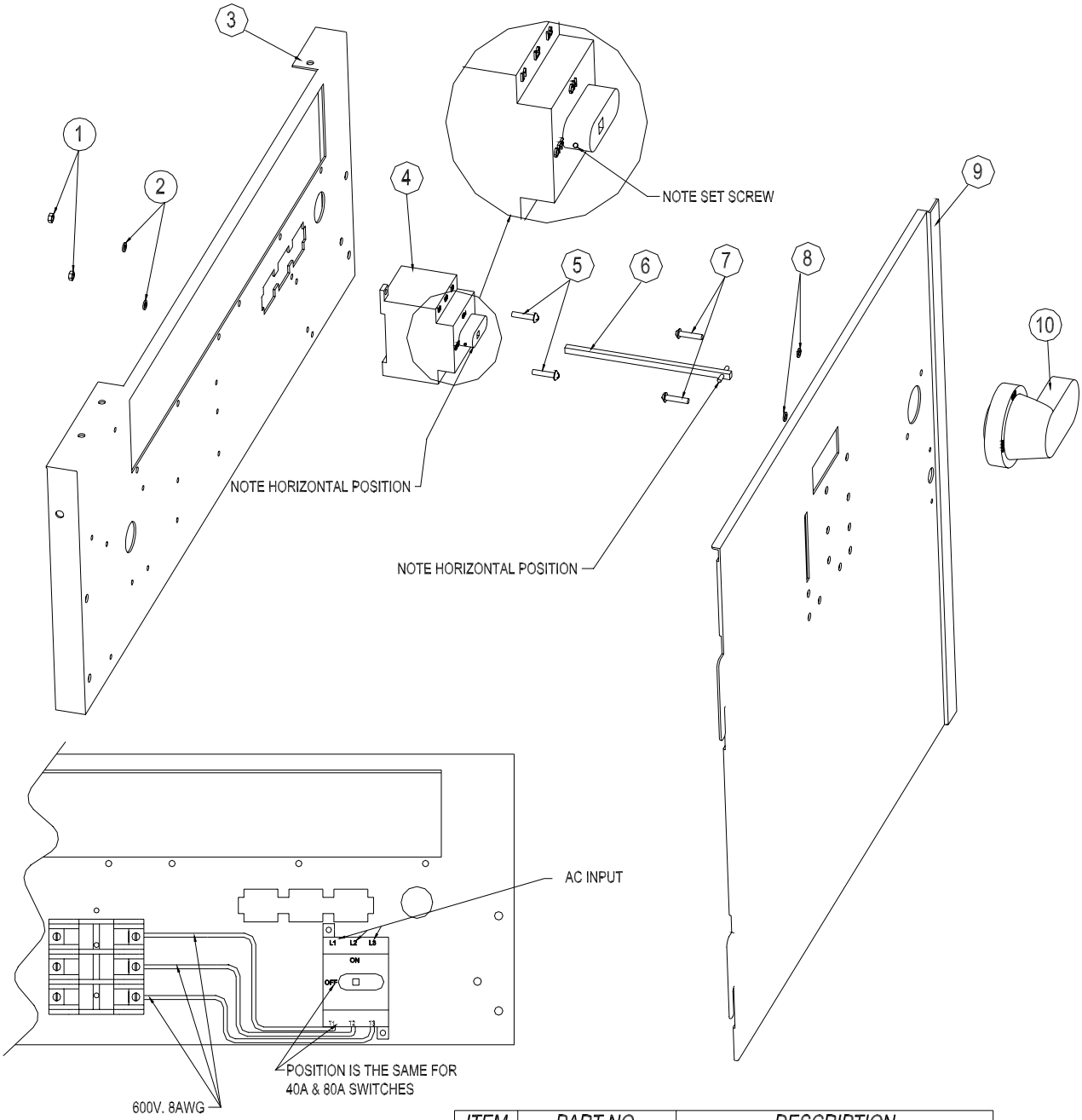
ITEM	PART NO.	DESCRIPTION
1	SEE BOM	3PH SUB-ASS'Y PANEL FOR SCR
2	SEE BOM	TERMINAL BOARD
3	SEE BOM	TERMINAL BOARD
4	SEE BOM	FUSE BLOCK
5	164-8-4	NYLON RIVET
6	036-4-67	BOLT, #8 X 1/2
7	074-2-2	#8 LOCK WASHER
8	X012-7-24	GROUND LUG
9	103-31-5	BOLT, 1/4-20 X 1, HEX HD
10	074-9-3	1/4 FLAT WASHER
11	074-3-10	1/4 LOCK WASHER, EXT. TOOTH
12	074-2-5	1/4 LOCK WASHER
13	007-3-51	1/4-20 NUT
14	074-7-9	#8 FLAT WASHER
15	074-3-18	STAR WASHER

NOTE:
1) WHEN APPLYING 100A FUSE BLOCK, USE THE CENTER EXTRUSION MOUNTING HOLE FOR BOTTOM ATTACHMENT. USE 036-99-2, #10-32 X 1-3/8" IN THIS APPLICATION.



A-A

DISCONNECT SWITCH (OPTIONAL)



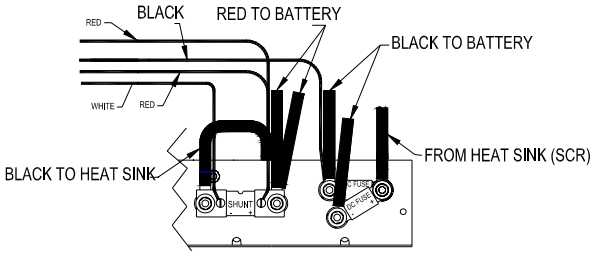
VIEW OF A 3PH. STANDARD CHARGER

ITEM	PART NO.	DESCRIPTION
1	007-3-21	#8 NUT
2	074-2-2	#8 LOCK WASHER
3	SEE BOM	SUB-ASS'Y PANEL
4	X002-99-0-45 X002-99-0-51	40A DISCONNECT SWITCH 80A DISCONNECT SWITCH
5	101-31-7	#8-32 X 3/4 SCREW
6	X002-99-0-47	ROD, CUT TO SIZE
7	PROVIDED	SCREW
8	PROVIDED	FLAT WASHERS
9	SEE BOM	DOOR FOR DISCONNECT SWITCH
10	X002-99-0-46	HANDLE

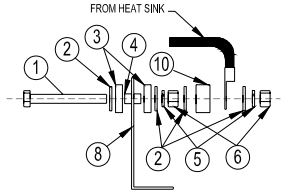
PARALLEL CABLES (OPTIONAL)

(Auto Start delay is required)

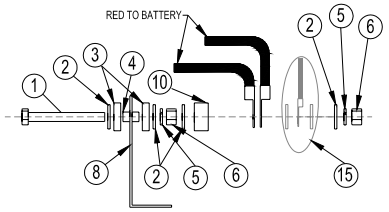
NOTE: DETERMINE NUMBER OF SHUNTS, FUSE TYPE, & CABLE SIZE FOR THE CHARGER. THEN, REFER TO THE APPROPRIATE ILLUSTRATION.



ANY SIZE PARALLEL CABLES

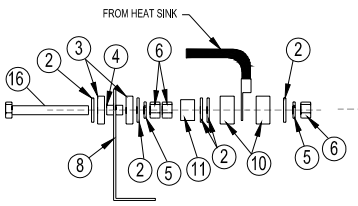


SINGLE SHUNT (NEG SIDE)

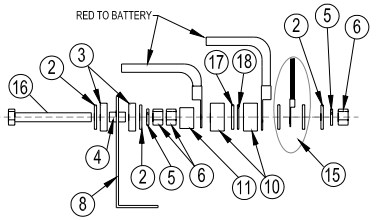


SINGLE SHUNT (POS SIDE)

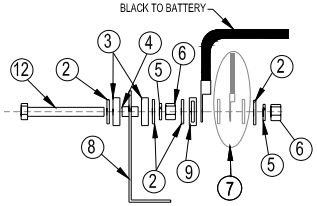
ANY SIZE PARALLEL CABLES



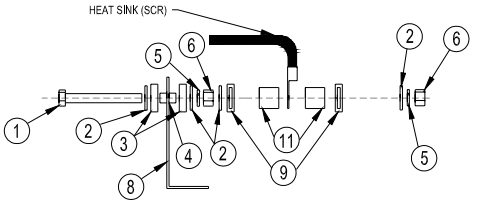
PARALLEL SHUNT (NEG SIDE)



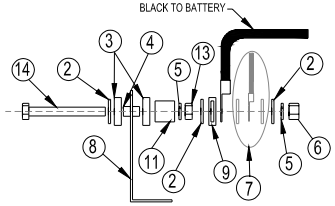
PARALLEL SHUNT (POS SIDE)



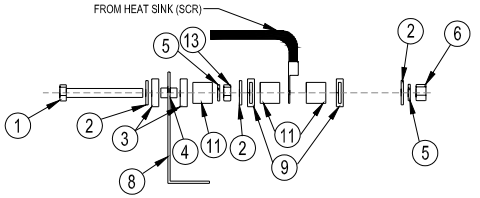
DC FUSE TYPE ANN, NEG (-) (TOP)



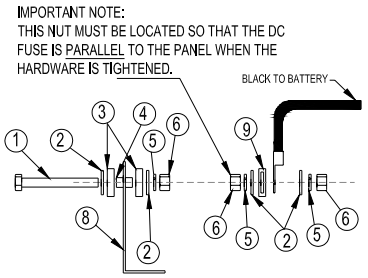
DC FUSE TYPE ANN, POS (+)



DC FUSE TYPE FWA, NEG (-) (TOP)



DC FUSE TYPE FWA, POS (+)



DC FUSE (ANY TYPE), NEG (-) (BOTTOM)

ITEM	PART NUMBER	DESCRIPTION
1	042-7-75	5/16-18 X 2.75 HEX HD BOLT
2	074-7-16	5/16 FLAT WASHER, ZINC PL
3	044-2-18	INSULATION WASHER
4	055-1-85	INSULATION BUSHING
5	074-2-6	5/16 LOCK WASHER
6	007-3-71	5/16 HEX NUT, ZINC PL
7	074-4-6	BRASS WASHERS & BLACK LEAD
8	SEE BOM	HEATSINK MTG PANEL
9	SEE BOM	DC FUSE
10	SEE BOM	SHUNT
11	006-207-2	SPACER
12	042-7-42	BOLT, 5/16-18 X 1.75
13	007-3-73	5/16 JAM NUT, ZINC PL
14	042-7-52	BOLT, 5/16-18 X 2
15	074-4-6	BRASS WASHERS & RED LEAD
16	042-7-76	5/16-18 X 3.50 HEX HD BOLT
17	074-6-6	5/16" DIA. X 1/16" COPPER WASHER
18	074-6-3	5/16" DIA. X 1/32" COPPER WASHER